

ELECTRIC FLIGHT U.K.

ISSUE No. 84 SPRING 2006



**THE MAGAZINE OF THE
BRITISH ELECTRIC
FLIGHT ASSOCIATION**



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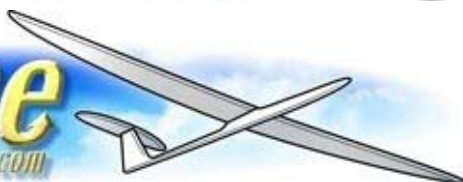
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the British Isles and Elsewhere" - B.E.F.A. Constitution

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Cover Photo: The cover photo is John Bowerman's Sprite aerobatic model. It has a wing span of 52" (132 cm) and is designed for motor such as the AXi 2820/10 or 12 with 3S LiPo around 3700 mAh. More details of the model, including how to get the plan, start on page 55.

NEXT ISSUE. The copy date for the Summer 2006 issue is 31 May 2006, with the magazine due for publication by 30 June 2006.

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| | |
|---|--|
| Chairman | Robert Mahoney 123 Lane End Road, High Wycombe, Bucks. HP12 4HF Email: <i>befa@rlmahoney.co.uk</i> |
| Secretary EF-UK Editor Webmaster South West Representative | Jan Bassett 111 Plantagenet Chase, Yeovil, Somerset. BA20 2PR Tel. 01935 472743 Email: <i>secretary@befa.ef-uk.net</i> or <i>editor@befa.ef-uk.net</i> |
| Treasurer Membership Secretary Northern Representative | Bob Smith 1 Lynwood Avenue, Tollesby, Middlesborough, Cleveland. TS5 7PD Email: <i>bob.smith007@ntlworld.com</i> |
| Events Co-ordinator | Terry Stuckey 31 Dysart Avenue, Kingston-upon-Thames, Surrey. KT2 5QZ Email: <i>terrystuckey@blueyonder.co.uk</i> |
| Competition Secretary | David Perrett 10 High Lees, Sharnford, Leicester. LE10 3PW Tel: 01455 272297 Email: <i>d.l.perrett@btinternet.com</i> |
| Midlands Representative | Roger Winsor 14 Butler Gardens, Market Harborough, Leics. LE16 9LY Email: <i>Rogerwinsor7@aol.com</i> |
| Welfare Officer Southern Representative | Dave Chinery 251 Station Road, Hayes, Middx. UB3 4JD Email: <i>DavidDchinery@aol.com</i> |
| Indoor & Free-Flight Rep. | Gordon Tarling 87 Cowley Mill Road, Uxbridge, Middx. UB8 2QD Email: <i>gordon.tarling@ntlworld.com</i> |
| Technical Liaison Officer | Alan Bedingham 17 Highcliffe Close, Wickford, Essex. SS11 8JZ Email: <i>bbba18333@blueyonder.co.uk</i> |
| Public Relations Officer | John Thompson 19 Park Avenue, Liversedge, West Yorks, WF15 7EQ Tel. 01924 515 595 Email: <i>johnty99@ntlworld.com</i> |
| Safety Adviser | David Beacor 34 Chestnut Close, Brampton, Huntingdon, Cambs., PE28 4TP. |

Please enclose an SAE with all correspondence to the committee.

Chairman's Chatter

Dear members,

I must first start with a thank you for all the good wishes I received after my short illness! I was at our AGM for a very short time (30 minutes) to present John Lewthwaite with his life membership. This was given to John for his support to Electric flight in the UK, and to BEFA, in letting us use his flying field for our competition events over many years.

The Middle Wallop fly-in, on 1st & 2nd July, will have all channels available on both days. There will also be a free pilot's raffle on the Sunday, for pilots who fly their models that day.

The 2006 membership renewal form should be enclosed with this issue, if for some reason it is missing please download one from the website or contact Bob Smith.

I am sorry this is a short chairman's chatter this time.

KEEP THE WATTS UP!

Robert Mahoney

Current Lines

from the Editor

Well, this was to be my 20th and last issue, however, I've been asked (and agreed) to do one more issue by the new Editor, Jill Day, as she is unable to take over the reins until June. Due to this I've left my details against the post for this issue so that items are sent to me. Jill's address to be substituted in the next issue.

Even after Jill takes over the Editor's position I won't be disappearing from the scene as I've offered to read and provide comments on articles to help out. I hope to be able to submit articles to Jill on the model building that I want to get on with. I do hope to see a considerable number of you at the 3 BEFA fly-ins (Middle Wallop on 1st & 2nd July, Leamington Spa on 6th August and Hayes on 3rd September)

Those at the AGM will also be aware that I've taken over the Secretary's post. As the AGM agreed to the addition of the Welfare Officer post (Dave Chinery elected) I've had to re-jig the committee list to make more room. I've now grouped the positions held under each person to reduce the previous duplication of names.

Please continue to send me articles and photographs so that the content of EF-UK remains varied and interesting. As we near the start of the flying season, why not send me a photograph and details of any models you've built over the winter?

Regards

Jan

New-2-U

A Brief Round-up of New Items of Interest.

If you are a manufacturer or retailer that has something new they want to share with the readers, please send details to the Editor (addresses on page 4).

First up is a range of interesting new brushless outrunner motor, incorporating a built-in spinner, from Robotbirds. They each have a rear mounting flange, which can be removed if desired. There are 3 different sizes:

The 380, which is 1770 rpm/v and for 2 - 3 Lithium cells. The spinner is 30mm diameter and the length is 43mm, with a weight of 30g including the mount. The maximum rating is 9A for 30 seconds, and the recommended model is 300 - 600g. This motor is intended for 6" x 3" or 7½" x 4" blades (not included) and costs £34.95

The 500 is 1200 rpm/v and is also for 2 - 3 Lithium cells. The spinner is 40mm diameter x 50mm long and weighs 51g including mount. The maximum rating is 15A for 30 seconds, and model weights 400 - 800g. This motor is suitable for 7½" x 4", 8" x 4½" or 9" x 5" blades (not included) and costs £34.95



The HCS C Compact 500 - Spinner Outrunner Motor

The 700 is 1485 rpm/v and is also for 2 - 3 Lithium cells. The size is the same as the 500 and the weight 58g including the mount. The maximum rating is 20A for 30 seconds, and the recommended model is 600 - 1200g. This motor is designed for 8" x 6", 9" x 5", 10" x 6" or 11" x 8" blades (not included) and costs £39.95

Also now available from Robotbirds are pair of light weight, 25mm diameter, plastic wheels complete with aluminium axles.

The wheels are solid plastic (i.e. no tyre). The axle part is designed to fit onto the end of a 2mm carbon rod, making them an excellent



solution for shock flyer type planes.



A set of these wheels and axles are only £2.

More information on these or other Robotbirds products can be found on their internet shop site at <http://robotbirds.com/catalog>

Aurorra Ltd have recently added 2 data logging devices to their range of products, the DPR-50 and DPR-100. These are designed to be fitted to your model, between the battery and controller, to record current and voltage data in-flight.

The specifications are:

- Very small: 1.2" x 1.6" (30 x 40 mm)
- Very lightweight: approximately 0.9 oz. (25g)
- Accept a wide range of voltage inputs: 7 to 30 Volts
- Digitally record up to 9+ hours of flight data
- Records and graphs in-use
 - o Current draw up to 50A (DPR-50) or 100A (DPR-100)
 - o Power output up to 1500W (DPR-50) or 3000W (DPR-100)
 - o Amount of charge used
 - o Battery efficiency (voltage drop under load)
 - o Elapsed time of each mission
 - o 2 independent temperatures using a dual probe (sold separately).
- Configurable
 - o Data sampling rate
 - o Recording trigger
 - o Channels to record
 - o Computer graph displays with provided software
 - o Recording resolution
- Very easy to set up and use!

Each DPR package includes the Digital Power Recorder (DPR-50, or DPR-100), a 3 ft (1m) USB-A to Mini-B interface cable and a CD ROM with powerful DPR graphing software, USB support files, and soft version of the user's manual.

The DPR-50 is £70.00, the DPR-100 is £83.43 and the dual temperature probes is £10.58.

Aurorra can be contacted at 108 Wheel Lane, Grenoside, Sheffield, S35 8RY, by telephone on 0114 257 0401 or through their website at www.aurorra.co.uk



Also now stocked by Aurorra is the FMA Direct OPTO4, a 4 channel opto-isolator. This unit is intended for use in models with long servo cables, to ensure that any interference picked up in the servo lead is not transferred to the receiver. It features twin battery inputs; one for the receiver and one for the servos. The unit is 1.95" (50mm) long, weighs only 0.4 oz.(12g) and costs £35.25



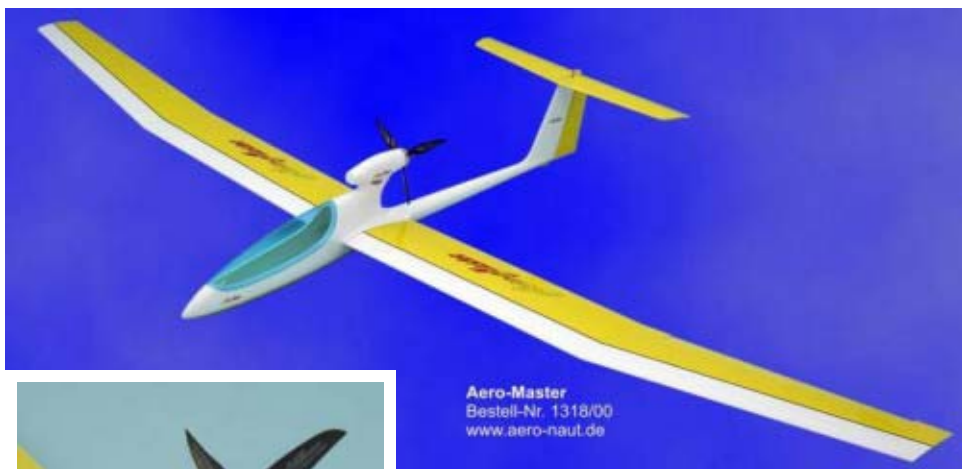
Recently introduced by Aero-Naut is the Aero-Master, which is a development of the highly successful Aerofly. The new kit features a taller GRP fuselage which can now accommodate a much wider range of power systems, as there is clearance for up to 10" diameter propellers. The wings panels are supplied factory-assembled and are of built-up construction, fully sheeted in balsa, ready for covering or painting. The modified MH 32 wing section allows a broad speed range.



The kit contains comprehensive building instructions, general arrangement plan, GRP fuselage, ready-made wing panels, all wooden parts, internal formers and miscellaneous items.

The wingspan is approx. 2.5m (98½"), length 1.15 m (45¼"), wing area 45.5 dm² (705 sq.in.) and weight with 8 Sub-C cells is around 1.75 kg (61 oz.). The model is designed for Rudder, Elevator and Motor control.

The recommended motors for 8 Sub-C cells are Actro C6 with 10" x 8" or 3-bladed 10" x 6", Actro CL5 with 3-bladed 10" x 8" or Actro CL4 with 10" x 7" or 3-bladed 10" x 5". These all give approx. 175 - 200W at 25A - 28A in-flight (<40A static).



[Editor: I think the Aero-Master would be excellent with a 3S LiPo pack, more power and lighter weight at the same time].

When using a 3-bladed propeller with this model, the Aero-Naut 3-bladed precision hubs and spinners are an excellent choice.

The Aero-Master should be available through all Aero-Naut stockist at around £160.

This issues final items are Aero-Naut Precision Hubs & Spinners mentioned above.

The 2-bladed version is available in 36mm, 38mm, 40mm, 42mm & 45mm spinner diameters for 4mm, 5mm or 6mm shaft sizes. They are supplied as a CNC-machined Aluminium base plate, a M8 collet, Impact-resistant plastic cap and retaining screw.

In addition to the spinner, a standard Aero-Naut folding propeller yolk (to suit the spinner) is required. The price for the 2-bladed hubs should be approx. £11 to £15, with the yolks being around £5 - £8.

The 3-bladed version is available in 36mm, 42mm or 65mm diameters also for 4mm, 5mm or 6mm shaft sizes. An Aero-Naut 3-blade propeller yolk is also required.

The 65mm spinners are designed for use as a non-folding propeller. The 3-bladed spinners should be around £13 to £18, with the 3-bladed hubs being approx. £10 - £12



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First Steps in RC Electric Flight

by Ewan Lee (Photos: John Digby)

Background

I decided to get back into aeromodelling after a 20 year break due to the impending birth of our first child; it was either now or wait several more years! With this in mind I needed a model that was going to be quick to build, reasonably priced and perform the task of trainer and performance flyer further down the line (I guessed I wasn't going to have much time to build anything else).

After various discussions with fellow flyers I decided to try an electric glider as this would fly nice and slow during the learning phase and if chosen carefully should be a good performer in thermals once I was proficient enough to find them.

I chose the almost ready to fly Filip 600 made by RCM-Pelikan and supplied by Puffin models. My choice was based on recommendations from experienced flyers along with good reviews and write ups found on various web sites. I'd certainly recommend the web as an excellent source to research your intended purchase.

Puffin models also recommended a motor (Permax 600 7.2V), speed controller (Rondo 600 pro) and propeller (Graupner folding, 9x4½) combination for the drive train and I purchased these with the model.

Building

The kit arrived, well packaged without any damage. The wings are ready built along with the rudder and tailplane/elevator assembly leaving the fuselage to be assembled to suit the radio gear etc... to be fitted.

The build is straight forward and quite well detailed in the accompanying instructions. I won't go into the fine detail but it was within the talents of someone who hadn't picked up an exacto knife in over 20 years.

I was severely tempted to try to reinforce the wing and tail fixings but at the advice of a fellow flyer I decided to stick resolutely to the instructions. I think I would have ended up adding too much weight which would only result in greater momentum during any impact.

The only modification I did make was to the battery mounting plate. I added a small 1/8" balsa bulkhead on which the battery mounting rested instead of the small piece of spruce strip intended for the job. I also added a small piano wire hook at the back of the battery mounting plate and a dowel peg at the front so that I could hold the battery pack in place with a sturdy rubber band.

The only other departure from the instructions was the canopy fixing, I couldn't understand how the fixings supplied with the kit were supposed to work so I just use tape instead.

There is a range quoted in the instructions for the position of the CG measured from the leading edge. I positioned the battery pack and other components inside the fuselage so that I had the required adjustment over the CG by moving the battery alone, I didn't want to add any lead to get the CG right later on.

The Hitec HS81 servos I used fit very neatly into the fuselage allowing plenty of space to move them around to align them perfectly with the control pushrods running up the fuselage before gluing the servo plate in place.

The whole build took me about four weeks, I guess a competent builder with time on their hands would at least halve this. Now I just had to wait for a good Wednesday afternoon for the maiden flight.



Here's the happy pilot Ewan, in traditional pose with his Filip 600

Flying

The wait was a lot longer than expected due to the appalling summer we had this year and in the end the maiden flight was in far from perfect conditions. The wind was blowing at about 16 mph and was showing no signs of easing when my fellow flyer/instructor, Rob, decided it was time to give it a go.

The Filip was given a good heave and climbed away on full power as steady as rock straight into the breeze. Rob was very impressed with its performance and I had



Inside the nose, showing the back of the motor (speed controller is soldered directly to the terminals, good choice of Power-Pole connectors and Hitec HS81 servos

a quick 10 minute flight with it myself just pointing it into the wind and slipping it left and right on the rudder.

Getting the Filip back to earth proved the hardest task and it took several approaches before Rob managed to get it on the ground. It finally came to rest upside down but survived without any damage to fly another day.

Further flights have been limited this year by the weather and the need to decorate a nursery but I have been able to build up my experience to the point where I can land the model myself in still conditions and fly circuits without too much help from my fellow flyers. I can't stress enough how important it has been to have experienced flyers with me to take over when I've got into difficulty.

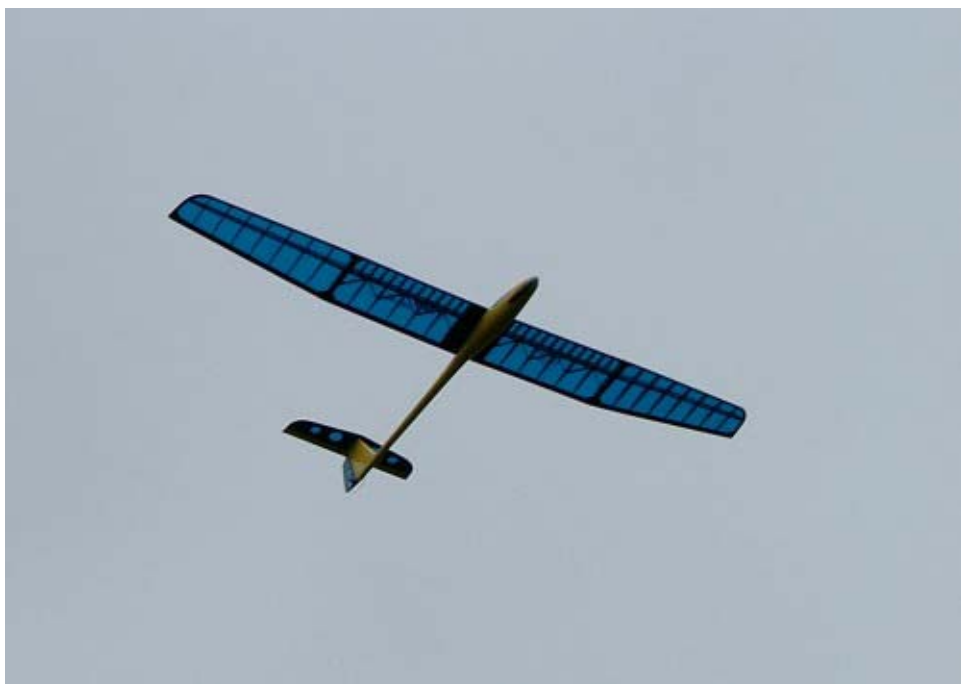
The Filip would certainly not have survived the summer without them. As a trainer the Filip has been ideal. The relatively slow speed of the model gives you plenty of time to correct mistakes and by flying with plenty of height stalls can be recovered easily.

The performance of the Filip 600 on a 7 cell 2200mAh NiCd pack is excellent. I regularly get flights of 25 minutes. On one occasion I managed to find thermals to circle in and the Filip climbed to the point where I was worried I'd loose sight of it,



Ready to launch...

Fly by...





Fly Over...

this amazed me bearing in mind the model is carrying a 7 cell NiCd pack and 600 size motor.

To sum up I would say I am very pleased with my choice of model to get back into the hobby. The Filip 600 has proved a good trainer and has the promise of a good thermal soarer when I get more proficient at finding lift

Numbers:

Radio gear:

Hitec HFS-04MI+ Receiver

2 off Hitec HS81 servos

Measurements:

Fuselage length 115 cm

Wing span 200 cm

Wing Area 38.2 dm²

Weight (all up) 1300g (RCM-Pelikan's target is 1250 – 1300g)

Cheap Indoor RC

by John Thompson

We first saw this unique biplane twin pusher model at the BMFA NW Area indoor meeting at Rochdale.

David Lloyd-Jones had one and was passing the TX around for seemingly ages.

He had bought his from Maplin Electronics so a visit was made to the Leeds branch. There was a pile of these models reduced in price from £29.95 to £19.95.



This includes the excellent TX which doubles as charger for the Lithium battery built into the model and all that is needed are six AA batteries.

Steering is by differential throttle on the Contra-Rotating motors, and so the Mode 2 TX has throttle on the left and steering on the right. Wings and fuselage pod are a foam moulding, with a tubular plastic boom and Depron tail feathers.

Four different spots on 27 MHz are available, identified by the colour schemes. Wingspan is just under 9" (220mm) and weight 20g!

Charging is simple just plug the pigtail from under the transparent screen on the TX in the socket under the model and wait for the LED to go out. The turning circle is not tight, you would not fly this in your average living room, which is probably why they were reduced in price, but in a Gym there is plenty of space for figure 8s. I have flown mine at full length of a 5 Badminton court hall without range problems, and flown two on adjacent spots.

Passing shock flyers cause interesting gyrations due to turbulence but nothing

else. The flight trim is near the stall, probably to ensure a tight turn. The week after the word had got around and Maplin had sold out, but we did get a few later at an even cheaper price when a toy chain was closing down.



Some have had problems with the tiny charging socket. Recently I gave a lunchtime talk on electric flight to the local Rotary Club and finished off by flying mine around the dining room.

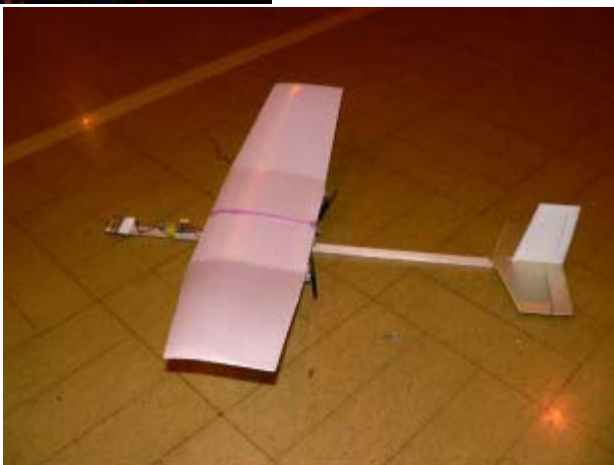
We have also flown them at the Pontefract and Dewsbury Club meetings.

Dewsbury Clubmate Doug Potter, always the innovator, has removed the guts and

fitted them into a stick model with larger Depron wing.

In doing so he discovered the whole model is powered by ONE 145mAh LiPo!!!!

His model needed quite a bit of tweaking before satisfactory turning was accomplished but eventually by lowering the pylon and towing the pusher motors out he has been successful.



It would seem that a lot of thought has gone into this design, the soft nose and pusher props make it safe.

The contra rotating helps to give direction stability, and the short span of the biplane wing improves the turning rate.

[Editor: maybe we can get a plan for a future issue - I'll see if I can arrange something]

TLC from your TLO

By Alan Bedingham

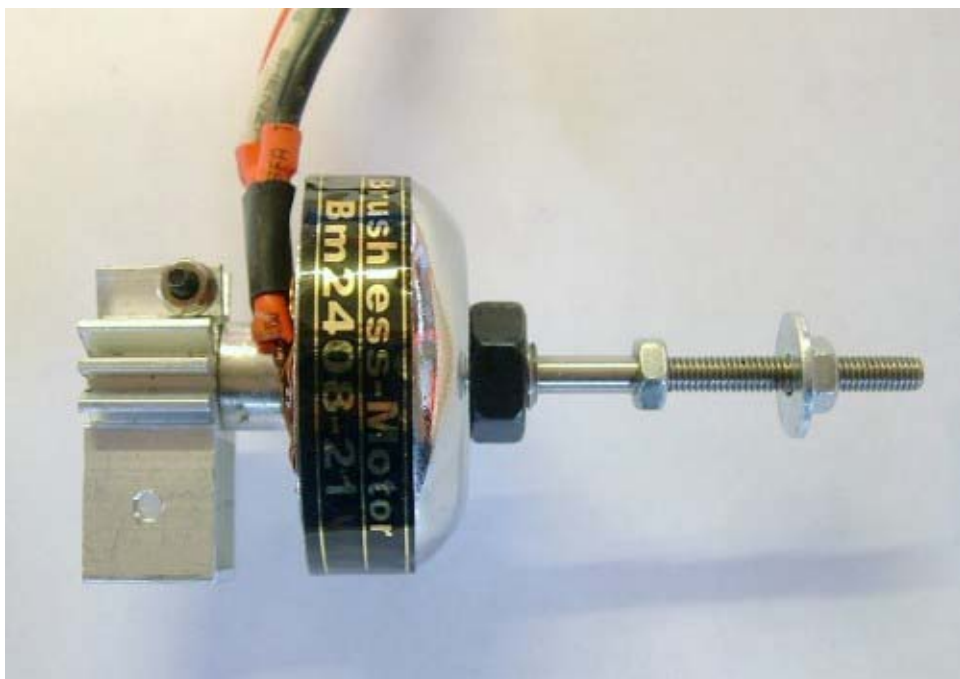
It's not often I have to eat my words and rarely so quickly! You may remember a couple of issues back I was discussing different types of motors, and when I got to brushless motors I suggested that it wasn't worth buying little ones to replace Speed 400s because the cost for a big motor wasn't much different.

Well, I've found a brushless outrunner and speed controller combination that will work in Speed 400 models and that you can get for around twenty quid! I got mine from RCM Direct and I paid thirty quid of course, mind that was a while ago.

Looking in the latest mags the price has dropped to around twenty quid, just my luck! How do they do it? I know labour must be cheaper in China, but I just can't work out how you can *make* these two for twenty quid, let alone ship them halfway around the world and still make a profit.

I was in a florists the other day buying some flowers for 'er indoors (got to keep on the right side of she who holds the purse strings you know) and they were telling me that most of their flowers came from Colombia. Colombia? That's crazy, how can it possibly be economic to ship perishables like flowers 5000 miles? Am I the only one who's bewildered by it all?

Sorry, down to business with a review of the little beast.

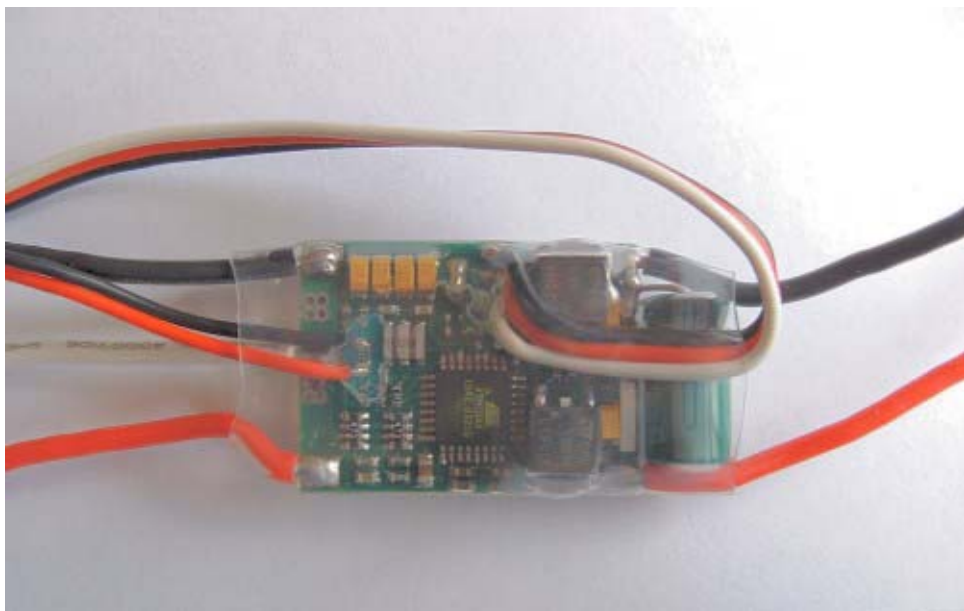


The label says Bm2408-21 which, I suspect, can be translated as a brushless motor with a 24mm diameter and 8mm wide stator wound with 21 turns. In other words, the usual gibberish that's no use to us.

I would call it a 140-3 i.e. 140W and 3S Lithium maximum. 3S Lithium is, for those of you who haven't been paying attention at the back there, 3 series connected Lithium cells or about 9 NiCd/NiMH cells.

It looks a bit agricultural at first glance but it is actually quite nicely made with good quality machining and powerful (probably Neodymium) magnets. The only place it would lose out to, say, an AXi, is that it appears to have plain bearings rather than ballraces – I haven't figured out how to get it apart, so I can't be sure.

Then again, Speed 400s have plain bearings and no-one seems to worry too much about it. It weighs a bit less than 2oz. (56g) as you see it, around $\frac{3}{4}$ oz. (21g) less than a Speed 400. The mounting bracket has a $\frac{3}{8}$ in square hole, the same size as GWS stick mount motors, and the shaft is 3mm to fit GWS propellers. Spotted the target market yet?



The speed controller I got is labelled HM-15A, dunno what the HM stands for, but the 15A is self explanatory. I notice that some of the twenty quid combinations come with only a 10A speed controller, so maybe I didn't do so badly after all. Once again, it looks very nicely made.

The two thin wires coming out of the motor end of the controller go to a two pin plug fitted with a jumper that sets the low voltage cutoff (LVC) for the motor – jumper on for 2S Lithium, jumper off for 3S.

It has the usual whizzo features we take for granted these days like automatic adjustment to match the throttle stick throw and not starting if your throttle is wide open when you plug the battery in.

If someone had told me about these when I first started this electric flight caper, I would have laughed in their face, progress truly has been remarkable. Brake is enabled by default, you can disable it by putting the throttle stick to max, plugging in the drive battery, listen for four beeps, close the throttle and you will hear two beeps. It is stored in memory until you want to change it again.

It has a Battery Elimination Circuit (BEC) but the instructions have no recommendations on the maximum number of servos you can use, I would err on the side of caution and not use more than three.

It has one feature I really don't like. Instead of a discreet beep or two when you connect the drive battery, it plays a daft tune that gets everyone patting their pockets thinking their mobiles are ringing!

There was no information on suitable propeller sizes, so I did a bit of bench testing to get some idea of what to use. The batteries I used were 2S and 3S 1500mAh Kokam LiPo.

| Propeller | 2S LiPo | | 3S LiPo | |
|-----------|---------|------|---------|-------|
| 6" x 4" | 7.2V | 5.1A | 10.8V | 8.9A |
| 7" x 4" | 7.0V | 6.4A | 10.6V | 11.0A |
| 8" x 4.3" | 6.6V | 8.5A | 9.8V | 14.5A |

As you can see, the numbers are comparable to Speed 400 motors except that the last high current one is way above what a Speed 400 could handle. At no time did the speed controller feel hot and even the high voltage, high current run didn't seem to bother the motor. I've got no way to measure the efficiency, but it's got to be better than Speed 400s that normally peak at 60%.

Right, let's nail it to my poor battered old Picostick and fly it. I started with a 2S 1500mAh LiPo pack and a 7" x 4" propeller. Pretty good performance actually, it would climb quite briskly compared to the standard GWS geared motor, touch and goes were a breeze on our grass field and the 'plane felt much more lively.

The only down side was that the wings were bending more than usual because of the extra weight. In for a penny, in for a pound, let's try the 8" x 4.3" propeller. Blimey! I've never seen a Picostick go vertical before!

Loops were easy, any size I liked, I even got it to roll! Then my luck ran out, I was setting up a landing approach on the second flight in quite gusty conditions when one of the cane rods that holds the wing to the stick broke. It went in from about six feet up and that was that. All the expensive bits survived OK, but it was RIP time for my Picostick.

Next step is to put it in my Nigel Hawes Hawk. I need a different motor mount for

this and I've seen a bulkhead mount for £1.50 that'll be just the job. I'll let you know how I get on when the weather gets good enough to go flying.

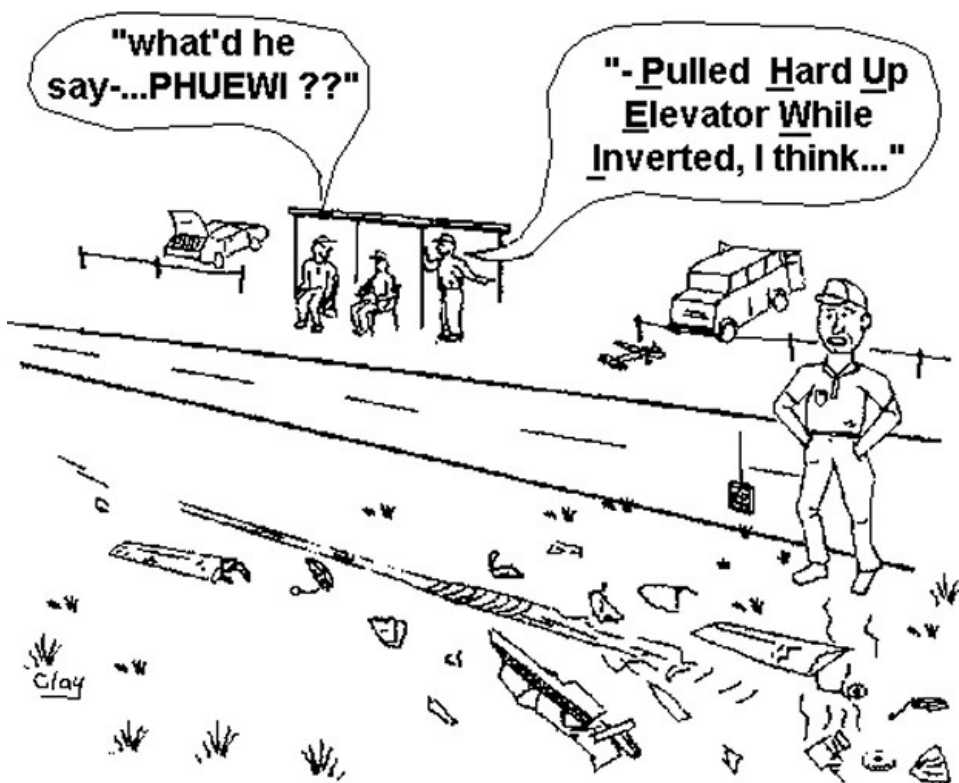
I used to go flying in all weathers when I was working, now I wait until it gets reasonably warm knowing I can fill my boots. This retirement lark is the best job I never had! *[Editor: Go on then rub it in!]*

By the way, if you're thinking of putting two of these in something like a Twinstar, remember you need a controller for each motor and the only leads you should extend are the ones between the motor and the controller.

Don't forget to pull out the red wire on one of the receiver connectors or the two BEC circuits may start to fight each other with dire consequences.

The instructions warn against extending the leads between the controller and the battery to more than 200mm total. The reasons are complex, but basically, long battery leads will let the smoke out of the controller.

So don't let the smoke out!



Pillerton Hersey 2005

by Robin Andrew

Once again we had nice weather, although the forecast had not been good. By lunch time 30 cars had eventually arrived. This included new visitors Tim Hooper, David Orme and John Shorthouse who used to be large petrol model flyers and Andrew Aske with his F-16. This made sure we had models flying all day.

Some exceptional gliding flights made by a 9' (2.75m) span flying wing, built from a German kit. Personally I love to see "Old Rubber" models converted to electric power, and several turned and flew well.

I awarded my Scale Cup to Tim Hooper for 2 lovely flights with his Bristol Freighter. He also flew other scale models that were in contention, including a 3 engined French freighter.

Stalwarts Richard Jones (EDF), Richard Few, Josh Spiers and Alf Andrews did their usual super flying displays.

On the following pages are photographs of the best bits. Many thanks to farmer John Lewthwaite and helpers for a lovely day out, which is not to be missed. I hope to see you all next year.



Richard Jones flew all of his EDF jets.

E.F.-U.K.



Above: This 'Old Timer' electric conversion flew well

Below: A lovely Hawker biplane, but the owner left before lunch after oly 1 flight





*Above: David Orme's 8' span stunter, Lancaster and Sea Fury (mostly out of shot).
Below: Tim Hooper's airforce, with 'special' Lysander*





*Above: Another view of Tim Hooper's airforce, including an interesting Quadriplane
Below: Tim Hooper with his French 3-engined model*





Above: Nice line up of converted rubber powered models by Tony Long

Below: Bob Moseley's exotic German kit fltng wing - 9' span - flew exceedingly well





Above: Richard Few & Josh Spiers arrived early with their models

Below: Andrew Aske and his F-16





Above: John Shorthorne brought his red Formula stunter

Below: A Lanzo Bomber built by Ray Haynes

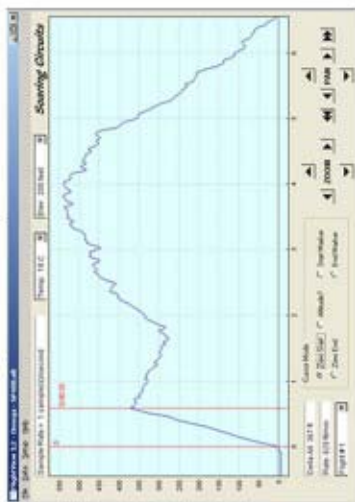


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A Staggerwing Conversion

by John Thompson

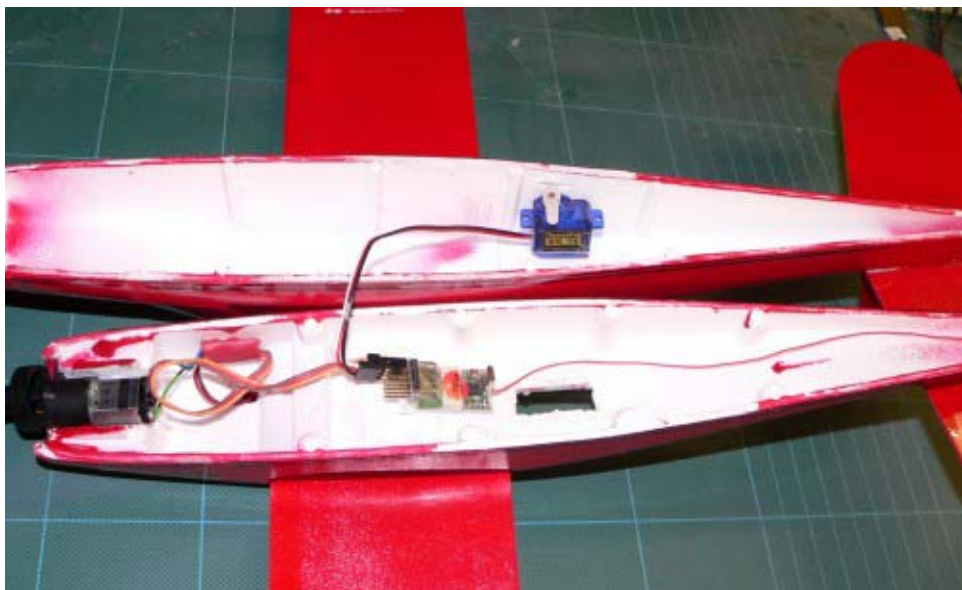
CC Lee make a series of beautifully crafted, foam, electric, free-flight, scale models for Perkins at around the £15 mark, and reports say they all fly well. Even the Spitfire is capable of Out Of Sight flight from a one minute charge of the internal battery. I bought the 20" (51 cm) span Beech Staggerwing a few years ago and the first (free) flight ended up in a tree about a half mile down wind.

Recently with the advent of cheap micro radio and the start of our indoor season, an RC conversion was considered. At the BEFA AGM I had bought a small planetary geared motor from Steve Metham's stand at about £12, and this would fit perfectly in the radial cowling.

The model comes ready to assemble and everything is attached with double sided tape. The fuselage is a top and bottom moulding joined already with a trim tape, and, as I was concerned about spoiling the painted finish, this was slit open with a sharp scalpel. I should have been more careful hear as there are locating pegs and sockets inside.

On the inside were a direct drive motor, three tiny cells and a PC board with charging socket/switch on it. The mouldings are superb, with extra strength were the motor and undercarriage plugs in , and the foam is quite dense but light.

Removing the motor was not easy as it glued in with some silicon like substance. The foam was then cut away to take the new motor ensuring the built in down thrust was retained.



A small LiPo capable controller was soldered on and then stuck to the fuselage wall, with the battery connection out through a small hole just in front of the lower wing. The RX is a tiny unit from All-Electric RC at £15 which has a short thin aerial, and was fitted just above the bottom wing.

A single Tower-Pro SG-50 servo was tried in various positions to get the balance right and finished up just behind the TE of the top wing. A short wire link was fitted to the tape-hinged rudder. The linkage could have been internal but is more accessible as it is. The model was re-assembled awaiting the delivery of a 2S1P 145mAh LiPo from Alan Fry.

During this time a longer undercarriage was made to give more ground clearance to the bigger propeller. The propeller is 5" black plastic, which features separate blades in a small hub. The gearbox has a quite long built-in propeller saver.

With this combination the current is only 0.4A, but a reasonable draft is produced and it scuttles along the garage floor at a good rate. A Günther prop was also tried but did not seem so good.

I fitted the 145mAh LiPo under the bottom wing with Velcro and the CofG came out on the LE of the top wing, which luckily seems just right. At an overall weight of 3.7ozs (105g) I have a true wing loading of 2.4 oz./sq.ft (7.4 g/dm²)!!

The test flight was not a success, with the model being underpowered. I need to consider options for improving the power available.



Learning to Love LiPo's

by Brian Rawnsley

For the last two years or so, the “sport flying” end of the electric flight scene has been revolutionised by two new innovations. Trips to the BEFA technical workshop and a look round the trade stands convinced me of this.

The two new innovations in question are Lithium Polymer (LiPo) batteries and small, affordable brushless motors and controllers.

The electric flight press, and motor calculation programmes give many facts and figures about these devices. For my own use, I have boiled these down to some simple rules of 10 and 20.

10 minutes is a good time of flight for a sport RC model. This gives time to complete a number of manoeuvres, “circuits and bumps” or whatever. Then, as a pilot, I feel it is time to land, “chill out,” change the battery, chat about the flight and prepare for the next one.

20 pounds is an affordable price to pay for any individual piece of in-flight electric or electronic equipment. By “individual piece of equipment” here I mean a motor, a speed controller, a battery, a receiver or a servo.

For LiPo batteries I think it boils down to having a battery capable of delivering current at ten times its charge rate (10C) or greater. Less than this and you end up with either a battery too big and heavy for the model, or a battery about the right size and weight but not enough power at full throttle for a good climb out. Recent LiPo battery developments have broken this 10C barrier.

For brushless motors, I am not sure what the “rule of thumb” figures are. I have made some discoveries by experimenting with a couple of small brushless motors (one geared and one direct drive outrunner).

I discovered that it is possible to get very good power to weight from a 2 cell (7.4 volt) LiPo, using a battery size matched to a motor where the current draw is equal to 10C at full throttle. I have also found that with this power to weight ratio, throttling back for cruise gets me the 10 minute flight.

There should be another figure concerning power to weight ratio, to give a good, safe rate of climb, but I do not have a simple one here. *[Editor: You could use the rule of 50 or 100. That is 50W/lb. for sport models and 100W/lb. for aerobatic models. This is a fairly crude system, but this general rule works well for most models]*

Having said this, is our hobby all about calculating numbers? Of course not, it is about enjoying the look and feel of a good model in flight, how it climbs, how it “sits” in the air, and exploring its virtues and vices.

I will share with you some examples of how some models of mine have been transformed by fitting some of this new technology.

The Mercury Matador

I have a vintage Mercury Matador, built from the Ben Buckle kit. I really built it as a tribute to my dad. In the 1960's when I was a boy, my dad built one of these from the original Mercury kit. He knew little about aircraft, but loved electronics and radio. I just liked planes.

Radio control equipment was a huge challenge at that time. To afford it, you had to build some yourself! My dad built a "Hill Mark 2" transmitter and receiver. The transmitter was much too big and heavy to hold, it sat on the ground. The transmitter aerial was eight feet long- an army surplus fighting vehicle antenna! It carried a 120 volt (80 cell) high tension dry battery!

The receiver sported two thermionic valves. When switched on you could see these glowing through the cabin windows. This receiver plus some heavy flight batteries made the model somewhat hefty, even when built lightly and tissue covered. This model lasted for one flight, damaged due to hard impact with a ploughed field, but it did fly, and sat nicely in the air.

My new Matador was built in the early nineties for electric power. The motor is an MFA Olympus 540 brushed motor with belt drive. Covering is Litespan. Control is rudder, elevator and motor. The battery was a 1250mAh 7-cell NiCd.



This combination produced many good flights, but the model has always felt a bit heavy. I never really reached that “guided free flight” feeling. Also the flights seemed to need full throttle all the time, so were a bit short.

Recently, I replaced this NiCd with a 2-cell, 10C 2000 mAh LiPo battery from All Electric RC, having established by measurement that the motor draws about 18A (just below 10C, which is 20 amps) at full throttle when lightly propped with a 10” x 6” wood. I also fitted a Jamara LiPo-Fly 25 speed controller.

This combination added several ounces of “lightness” and has noticeably changed the model’s flight characteristics. It now “ambles” in the air, and can be trimmed for nice, spiral climbs and descents a la “free flight.” This model has been saved from the bring and buy sale!

I do not think I am at the end of the “adding lightness” road with the Matador. I feel a small, brushless outrunner motor, matched with a smaller LiPo battery, somehow held in the nose cowl to preserve Centre of Gravity, could be worth a try.

The Sopwith Pup

As an avid park flyer, I have had many happy hours using a well-tried combination of GWS models (Pico Stick, then Cub), and Overlander 300 mAh 7-cell NiMH batteries. I was getting to a stage where I wanted to try some more difficult, scale subjects. Also the NiMH batteries were getting very “tired” after several seasons, and needed replacing.



The first “difficult subject” I tried was a Kavan Sopwith Pup park flyer. This is a very nice kit, all pre-coloured Depron. Lots of wooden struts- even wooden wheel axles! The model came with a geared 280 brushed motor. Flying with this and the 2-cell 640mAh 15C Kokam LiPo battery produced very marginal climb rate.

In went a 3-cell LiPo. This was much better- for about five minutes till the motor burnt out! Since then I have bought a 280 geared brushless motor and HM-15A speed controller from RCM Direct. This gives great climb performance with the 2-cell 640mAh LiPo 15C battery, so I am in business with a practical flying machine.

How does it look and feel in flight? Well, the first thing I noticed was the difference turning left and right. I imagine this is a bit like the real thing- where the combination of a short, stubby aircraft and large propeller gives a gyro effect.

Turns to the left (model is rudder / elevator controlled) are docile, and the model naturally climbs. Turns to the right are very snappy, the model whipping round to face in the opposite direction, very handy when the Red Baron is on your tail.

Ground handling is, surprisingly, not bad. The model can be flown in and out of a cricket pitch, with little tendency for the tail to swing. Cruising at half throttle between manoeuvres allows a 10 minute flight time.

The Pico Fli

I have developed what I call a “Pico Fli”. This is a Pico Stick with built up wings and ailerons in the style of a “Fun Fli” model. Until recently, this had the original



geared, brushed 150 motor. The model in this form was reluctant to perform manoeuvres. Mainly, I think this is due to a combination of the power-to-weight ratio and the large, geared propeller having a braking effect almost immediately when you dive to pick up speed.

This model was definitely heading for the bring-and-buy sale. I bought a small brushless outrunner “bell” motor and speed controller from All Electric RC, at the BEFA Technical Workshop. This I fitted with an 8” x 4” propeller, and powered by a 640mAh 15C Kokam LiPo battery.

This has transformed the model, which will now do “stunts” including consecutive, climbing loops. Again, a 10 minute flight time is achieved by throttling well back between manoeuvres.

What Next?

I feel confident now to proceed with other scale, higher wing loading, Park Fly subjects such as the GWS World War II fighters. I fancy a P-51 Mustang with a “bell” outrunner motor and 640mAh LiPo.

So, I have learned to love LiPo’s. All motor, battery and speed controller purchases met, or very nearly met my “rule of £20 per item” stated at the beginning. All of these combinations also achieve my “rule of 10 minute” flying time, and now have good power-to-weight.

LiPo’s have their well-known foibles such as sensitivity to over-or under-charging, and the tendency to go out of balance. *[Editor: Under charging is not a problem as it does no harm to the battery - just to flying time. However, over discharging certainly is a problem and must be avoided at all costs]*

These have not affected me yet, in the six months I have owned my LiPo packs. For me, provided they last for 50 or so charge cycles (another number rule!) I will be more than happy.

Any questions or comments, I will be pleased to hear from you at sandra@brianrawnsley.freeserve.co.uk



Road Testing Batteries

by Wayne Giles

I was intending to title this article “Quantifying Battery Performance”, but changed to the present title because people tend to shy off from technical articles with formal titles.

As I have changed the formal title bit, meet me half way and put up with the technical bit. I will try to minimise it, but if you fly electrically powered models then you must have something of a technical bent, especially if you are interested enough to join the BEFA.

Background

I am a life long modeller and a retired electronic engineer but only started flying electrically powered models about three years ago. The reason for this is that up until brushless motors appeared I had the view that the average electrical model usually staggered round on the verge of a stall or else it was a flying house brick because the owner had put in enough NiCds to try to produce real performance.

I always felt slightly guilty about this, having spent my working life in power electronics, but with the latest advances in outrunners and Lithium batteries I am now a convert and thoroughly convinced that electrically powered models can compete on a level playing field.

One of my first models was an IFO which I can fly in my garden and was purchased when they first arrived here. My recent I.C. flying had mostly been sport aerobatics with the usual Acro-Wot (OS 91FS) and scaled down versions. (Milli-Wot with OS 26FS and a Micro-Wot with an OS 15) Thus I am always looking for a fairly high power/weight ratio.

The IFO seemed rather underpowered and the agents were offering 7, 8 and 9 cell battery packs, so I uprated from the 8 to 9-cell pack with very little improvement. I investigated this problem and found that at full throttle the battery voltage was down to 6.4V - an average cell voltage of just over 0.7V!

The motor was a 280BB with a 3.7:1 gearbox and a 10” x 4.7” prop. I further investigated and found that the cells used were quite inadequate in current delivery terms and substituted 8 x Sanyo 600AE cells which cured the problem. I sent an email to the supplier, pointing out the problem, which was duly ignored but I noticed that they changed to 600AE cells shortly afterwards.

Last year I bought a Protech Ultimate Shock Flyer, fitted it with an AXi 2212/34 and a 700 mAh 3S1P LiPo battery (Unknown make but claimed to be 10C) and found it flew well enough, but felt it could do with more ‘urge’. I bought another battery, really because I needed two, this time a Kokam 720 and found a pretty significant increase in performance.

As I wanted a couple of batteries of the same performance, I tried to buy another, but Alan Fry talked me into a Kokam 740, probably because he hadn't got any 720's left. This absolutely transformed the performance of the model.

This set me to thinking that there must be a way of objectively quantifying the widely varying performances of apparently similar batteries. If you ask around for advice, however well intended, it is always subjective and must be distorted by other variable factors such as motor, propeller, aircraft weight or whether the advisor is actually trying to sell you batteries. What I wanted was an objective instrument which would just read out performance.

I should make it clear here that I wanted to measure the ability of batteries to deliver current, not their ability to store energy; i.e. flight performance, not flight time. In car terms, the intent would be to measure acceleration and top speed; not m.p.g. and tank capacity.

We are all aware that the ideal battery would have a completely stable output voltage capable of delivering infinite current without any voltage sag at all. In our real world every cell, whatever it's chemistry, has some series resistance built into it (ESR – Equivalent or Effective Series Resistance), and it is this which causes the voltage sag, or drop, at the battery pack terminals.



It also results in the heating up of the battery pack by the wasted energy which we would much rather went to the motor.

We can quantify this:-

The power, in Watts, lost in the battery is equal to the voltage drop (across the ESR) multiplied by the current.

As the voltage drop is equal to the ESR multiplied by the current

(Ohms Law : $V=IR$), then it follows, as Power = Voltage x Current, that the power lost in the ESR is equal to (ESR x Current) x Current.

That is Power Lost = $I^2 \times \text{ESR}$

The real problem here is that the power wasted in heating the battery pack is a function of the square of the current. Double the current and you are throwing away 4 x the power as heat in the battery.

All these laws of physics are beyond our control (despite what the public relations men would have us to believe), but we could have some control over the ESR value if only we knew which batteries had the lowest ESR.

Either by accident or design the manufacturers choose not to inform us. If challenged, no doubt they would say that the average user does not understand it or that it is not as simple as that.

The latter is true in a literal sense as battery impedance is made up of some pure resistance, some more resistance with capacitance in parallel & some small inductance.

The inductance is of no consequence to us and the parallel C/R combination is only a minor part of our problem so that as far as the modeller is concerned it is the pure resistance which is the villain. To be fair, manufacturers have always quoted an impedance figure, usually at 1 kHz, which I have always assumed is to help with the design of loads which have an A.C. element in them.

I had investigated the possibility of measuring ESR last year and had gone as far as building a rig which operated on a pulsed principle and produced a DC output voltage equal to the difference between off-load and on-load voltages at a set current. The ESR could then be calculated from these figures. This was before my experience with the Protech Ultimate and the three 700mAh LiPo batteries.

It was this latter experience which set me to thinking that there must be a way of building an instrument which would produce the results we want to know directly.

Although the actual value of the ESR is academically interesting to us anoraks, what the user wants to know is how efficient a particular setup is and how much power goes to the motor with a particular battery.

I had some wild idea about applying a linear current ramp load to the battery under test and reading the current level at which the battery voltage had fallen to,

say, 80% of its no-load voltage. This would then read out the current at which the battery would achieve an efficiency of 80%.

I was corresponding with Bob Smith about the problem at the time and he asked the question “Why not turn it round; start with the current, for a particular fixed power train, and make the instrument read out the efficiency?” This was obviously a much better way to proceed and it overcame a scaling problem caused by the square law applying to the battery losses.

Unit concept

Although the unit would produce an efficiency figure for the chosen current, it seemed to me that the other parameters of immediate interest to us would be the power going to the motor and, to drive home the message about I^2R losses, the power lost in heating up our batteries.

It was therefore decided to attempt to display these three figures for any chosen operating current. Using the same techniques that I had used in the ESR meter, I could derive both on-load and off load voltages and put these into memory.

Having an accurate analogue of the current used in the measurement, it was therefore possible to multiply this by the on-load voltage to give the power delivered to the motor and to also multiply it by the difference of the two voltage figures to give the power lost in the battery

The current pulse applied to the battery has to be accurately controlled and independent of the battery voltage, so that several large power FETs in parallel are used, driven and controlled by an operational amplifier.

Experience with the ESR meter had demonstrated that all batteries have a significant temperature coefficient and it is therefore important that the testing itself does not heat up the battery.

The ESR meter operated on a repetitive pulse principle with the output voltage being updated every second. Although this was a very small duty cycle, it still eventually warmed the battery and distorted ESR figures.

It was therefore decided to use a single shot principle and store the results. The three results are displayed on a 3½ digit LCD display, a 3-way switch choosing the displayed parameter.

The current is preset in 10A steps by a 10-way rotary switch, up to a maximum of 100A with a toggle switch adding 5A to give a range of 0 – 100A in 5A increments.

In terms of voltage, the unit will cope with 5 – 18 NiCd/NiMH cells or 2 – 6 Lithium cells, maximum power capacity being 2000W.

To operate the unit, the battery is connected to it via two 4mm front panel sockets and the current switch set to the required value. Pushing the “Operate” button will produce a reading in about one second.



The display is automatically stored and held until the next reading is taken. Any of the three parameters discussed can be displayed, but it must be selected before taking a reading.

Operation is so quick and easy that it was possible to take all the results in the table shown, ranging from 10A – 80A, in about 5 minutes.

The unit requires about 170mA at 12V dc which is normally supplied by a plug type PSU but it will happily operate off any 10 – 16V DC supply.

Results and how to use them

The best way to demonstrate the use of the unit is to look at the results taken from two comparable batteries and see how helpful conclusions can be reached.

I was looking to power a Graupner ASH 26 for some relaxed flying (It turned out to be the most stressful aircraft to fly that I can remember, but that is irrelevant to the present story) I was using a 700 Neodym which I had bought years ago and never used (modelling syndrome) and was determined not to waste

Suitably over-propped, it drew 40A from a 15V supply so that I was looking for a suitable battery and considered 12 x Sanyo RC-3000HV cells or 4S3P Konions.

I tried the Sanyos first as they were the cheaper, but the weight penalty later decided me to change to the Konions based on encouraging ESR figures I had measured last year.

I took a set of figures from each pack and have extracted the figures at 40A to show the information they give. The tests were carried out at 25°C, which is important – more of that later.

Displayed Results

| | Current Amps | Efficiency % | Motor W | Battery Loss W |
|-----------------|-----------------|-----------------|------------|-------------------|
| 12 x Sanyo 3000 | 40 | 83.3 | 537 | 108 |
| 4S3P x Konions | 40 | 84.6 | 564 | 104 |

These are the figures read directly from the unit, but other useful information can be derived from them:-

ESR of the pack plus connectors is given by dividing the battery losses by the square of the current.

The on-load voltage is given by dividing the load power by the current.

The off-load voltage is given by dividing the on load voltage by the efficiency.

Calculated Results

| | ESR mΩ | On Load Volts | Off Load Volts | Power/Weight Watts/Kg |
|-----------------|-----------|------------------|-------------------|--------------------------|
| 12 x Sanyo 3000 | 67.5 | 13.42 | 16.13 | 706 |
| 4S3P x Konions | 65.0 | 14.10 | 16.67 | 1029 |

(The weights of the two packs were Sanyos 760g and Konions 548g)

Interpretation of Results

The displayed results show that the two packs are very similar in performance, both in efficiency and in delivered power. This is because the ESR of the two packs is extremely close with a very similar off-load voltage. The calculated results show that the Konions have a 45% advantage in power/weight ratio.

I also took figures at 40°C which is a more realistic operating temperature, and they showed a 14W increase in power for the Sanyos and 20W for the Konions. The reason for this is that the curve of the temperature coefficient of ESR is steeper for the Konions than it is for the Sanyos.

You might look at the above comparison and say “So what” as the figures are very close. This is only coincidence in this particular case. Comparing other batteries has thrown up differences of 2:1 with efficiencies dropping alarmingly at higher currents.

When you retrieve your model after a flight and notice that the batteries are up around 40 - 50°C, you should think to yourself “All that energy wasted which should have gone to the prop”

To quantify this I took results from an 8 cell pack of good quality Sub-C NiMH cells from 10A – 80A and this is on the next page:

| Current Amps | Efficiency % | Motor W | Battery Loss W |
|-----------------|-----------------|------------|-------------------|
| 10 | 95.4 | 97 | 4 |
| 20 | 91.0 | 186 | 17 |
| 30 | 86.6 | 267 | 40 |
| 40 | 82.2 | 337 | 72 |
| 50 | 77.9 | 399 | 112 |
| 60 | 73.5 | 452 | 161 |
| 70 | 69.3 | 497 | 219 |
| 80 | 65.0 | 533 | 285 |

Note that the power lost in battery heat clearly shows the square law; take 30A and you throw away 40W in battery losses, take 60A and the losses rocket up to 161W; well over one third of the power going to the motor.

Also note that the first 10A of current delivers 97W of power to the motor, wasting only 4W in the battery whereas the last 10A of current adds a mere 36W of motor power, yet throws 66W away in battery heat.

I should point out that the cells in question are only intended for use at 40A or so, but the figures demonstrate that taking excessive currents from a battery give little return. In the case of Lithium batteries it also rapidly shortens their life.

I have used the unit to differentiate between Lithium packs with genuine 15C and 20C ratings from the “pretenders”. The latter types stick out like a sore thumb.

The other variable we need to be aware of is temperature. All batteries have a negative temperature coefficient of ESR so that they all work better at higher temperatures (within limits!)

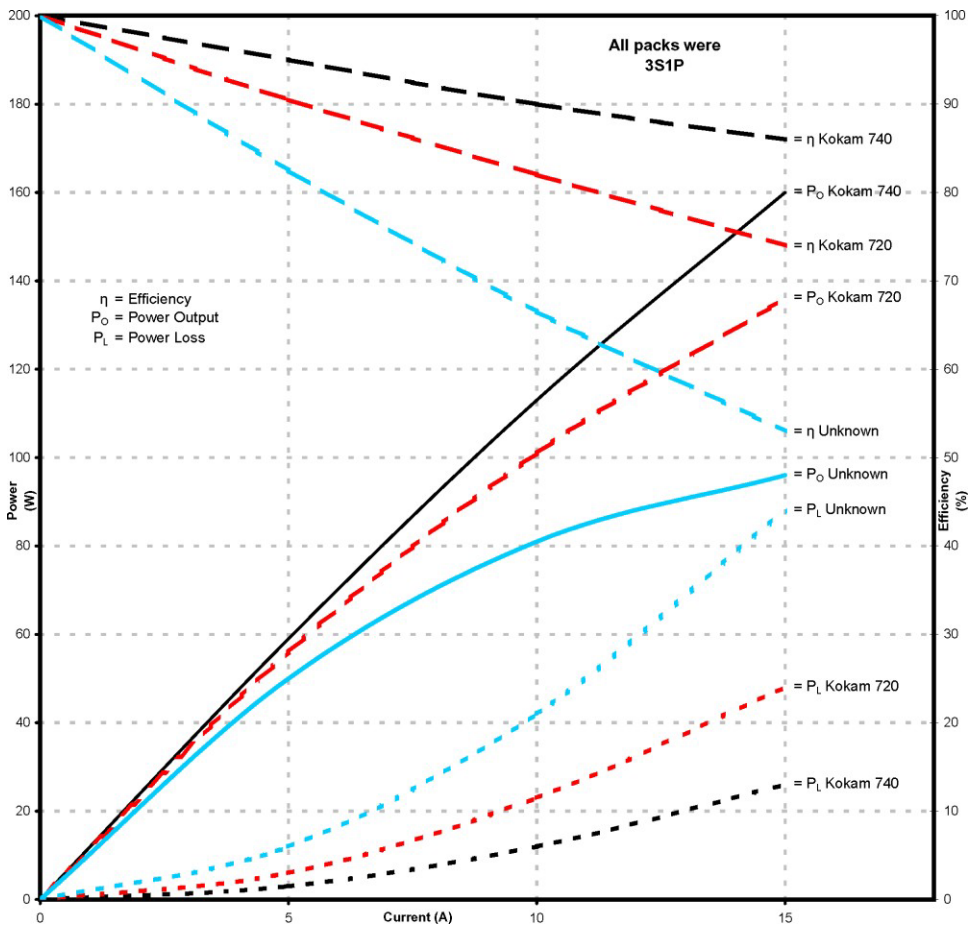
However, we need to be aware of how it affects results when comparing two battery packs, particularly if comparing cells of different chemistry. It appears that Lithium cells have the highest coefficient, NiMH next and NiCd the lowest.

It follows therefore that Lithium are at the biggest disadvantage at low temperatures, but what we are interested in is how they compare under practical conditions. I therefore try to ensure that packs are left to settle to the same temperature, as near as possible to 35–40°C before carrying out comparative tests.

The obvious mistake to avoid is to compare a just charged Lithium battery with a NiMH pack which has just been fast charged and is hot off the charger.

A good demonstration of the comparison of three notionally similar batteries is the results obtained from the three 700mAh lithium batteries which originally led to the instrument. They are all 3S1P LiPo packs, one of unknown make, one a Kokam 720 and the last a Kokam 730.

Rather than a table of results, a comparative graph showing efficiency and the two power figures has been plotted for all three battery packs.



The above shows how the unit will compare any two packs; the only problem is that you need to have both of them in your possession

It is noticeable how widely the performance of Lithium batteries vary, assumedly because the technology is new and some manufacturers have developed better techniques than others.

NiMH batteries, on the other hand, vary much less, presumably because the manufacturing technology is more mature and widely known within the industry.

I have never done any competition flying, but assume that it would be useful for the competition flyer to be able to instantly find his best battery pack.

Validity of Results

Although the instrument allows us to measure high power performance of our batteries, literally ‘at the touch of a button’ the reader may wonder of the validity of the results. I have calibrated the unit very carefully and tried to check results where possible.

The basic efficiency measurement which I originally set out to do, simply expresses the on-load voltage as a percentage of the off load voltage. As the current is common to the battery and the motor then this percentage figure applies to the power also. A very encouraging fact is that the two power figures, which are derived via a very different route from the efficiency always give the same result as the direct reading within about 0.5%. Repeatability of results also suggests that the measurement system is valid.

I would add a word of caution in calculating ESR values. As we use the “Battery Losses” power figure to calculate ESR, it is wise to take the measurement at the highest practical current. This is necessary because the reading is derived from a small difference between two large voltages, which will magnify any errors. Also any digital readout must be + or – 1 count, so that any reading of 9 or less cannot be better than 10% accurate.

The table of 10A – 80A results demonstrate this: if you calculate the ESR at each current you will see that the first two readings are 10% low and 6% low respectively whereas the results 30A upwards are consistent within 1%

As the unit can measure losses, from which we can calculate the ESR as described above, then it is possible to measure the resistance of other connectors and/or leads. To prove this I took a nominal 22 milliohm resistor, accurately measured its value with a high current and accurate instruments. I then soldered it in series with a battery on test. I calculated the ESR from the losses with the resistor in circuit and the ESR without it. The difference in the two values was equal to the known value of the resistor within 0.4%. I would not claim an accuracy of this level, but it suggests that a claim of 2% would be reasonable.

As the efficiency is quoted as a percentage, the voltage of the battery under test does not affect the result so that it is possible to compare a 3 cell Lithium battery with, say, a 14 cell NiMH battery - the efficiency figures are directly comparable. Only the power readings are affected by the different voltage and these can be quoted on a watts/cell basis so that the performance of a battery made up of any number of cells can be forecast.

Since building the prototype, three people have asked me to build one for them, so I am in the process of making a batch of six units. If there is enough interest, I may consider a second batch.

I would be happy to try to answer technical questions anyone may have and can be contacted by email at: [**marywayne@giles150.freeseve.co.uk**](mailto:marywayne@giles150.freeseve.co.uk)

Do-It-Yourself Brushless Motor

by Rob Ireland

“All the parts which didn’t break in the crash – were too heavy!”

This is my version of a DIY brushless 400-size motor, from the article written by John Rutter in Q&EFI Jan 2005.

Why bother?

It’s a good question! The outrunner type of motor (magnets revolving in the outer casing around a stationary core of windings) is very simple to make and as a result there is now a vast choice of these brushless motors available.

There are dozens of manufacturers advertising this type of motor at reasonable prices. There is a 10A motor including speed controller available for less than £20!

There are probably 2 reasons to DIY:

One is the same as all other DIY subjects – the strange pleasure which comes from fiddling with things we are not good at, triumphing in the face of adversity.

The other is the ability to tune the motor to the application. This can be done by altering the number of winds on the core (fewer winds – hotter motor, more winds – slower motor and bigger prop.). On this type of motor construction it can also be achieved by the length of the stator core laminations.

My motor...

I wanted to replace standard Speed 400 motors which are limited to about 10A and only 55% efficient, with a brushless motor having a capability of at least 15A at 85% efficiency. This makes the brushless motor over twice as good as the Speed 400, and it would also be lighter!

John’s article indicated that a motor built from 2 stators stacked together would be about right for my requirements. The finished weight was 1.5oz – half the weight of a Speed 400.

Parts required

You will need:

1. A speed 400 motor, new or used.
2. Twelve Neodymium magnets 12 x 4 x 1.5mm. These are available from George Mizzell, Engineered Concepts, 1836 Canyon Rd, Birmingham, AL 35216, USA. (***www.supermagnetman.com***). These currently cost 60 cents each (for up to 49 magnets, with discounts for larger quantities) and delivery is very fast. Payment can be by PayPal, credit card to fax +1 205 823 5607 or in US Dollars by cheque or cash.

3. Two stators (9 pole, 22.7mm diameter) at 85p each from C&K Designs, 14 Queen Elizabeth Dr., Corringham, Essex, SS17 7TH.

www.brushlessmotors.co.uk

4. A solder connection plate. This is not essential, but makes the winding connections much neater. 95p from C&K Designs.

5. Two ball races, 0.125" x 0.250". RS Components part no. 747-614.

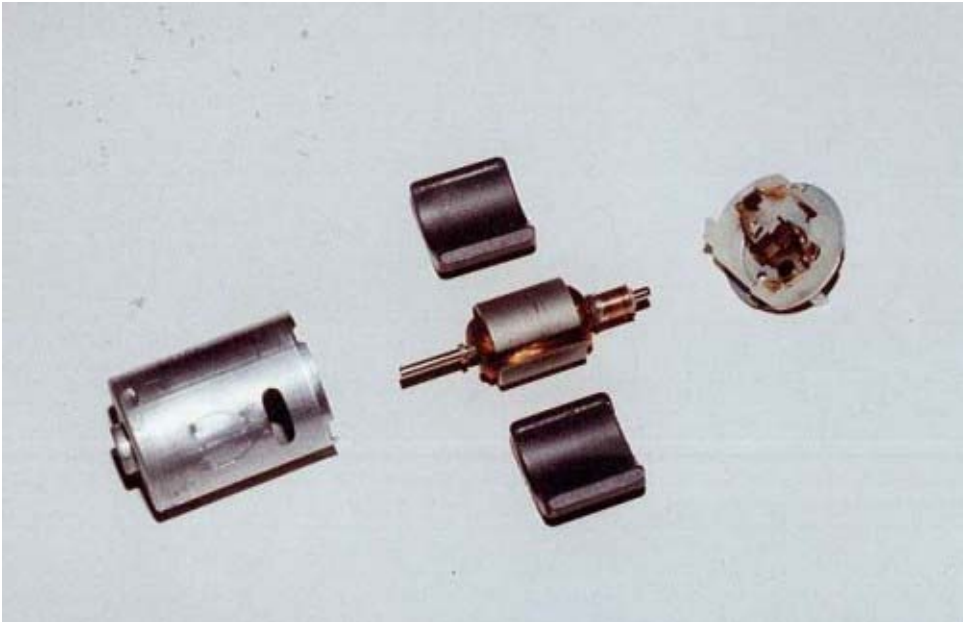
6. A drill blank, 0.125" diameter at about £1.12, available from Drill Service (Horley) Ltd., Albert Road, Horley, RH6 7HR, tel. 01293 774911 www.drill-service.co.uk.

7. A length of 8mm OD tube, carbon fibre or aluminium alloy.

8. Insulated winding-wire. 0.4mm diameter suited my motor. 0.5Kg reel available from RS Components, part no. 357-738. If you don't want to experiment with windings, smaller packs are available from C&K Designs.

How to do it.....

1. Take Apart a Speed 400.



File, prise or grind off the lugs at the brush holder end of the motor can. The brush holder can now be pulled free, with the armature following next. Remove the spring clip which retains the 2 magnets. The clip, magnets and armature can be discarded.

Carefully close the magnet retention wings nice and flush with the can. Any protrusion of these on the inside of the can will affect the seating of the new magnets.

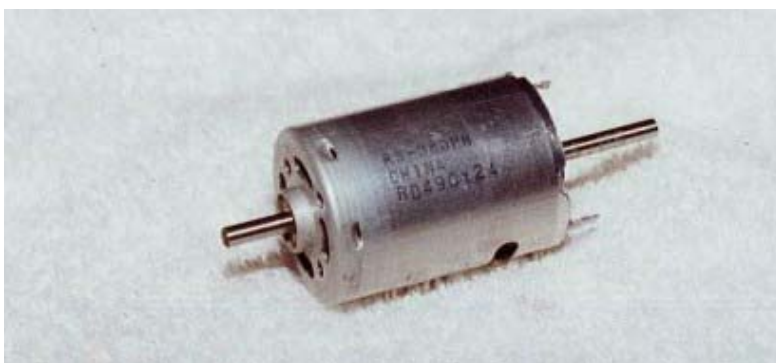
2. Drill out the Brass Bush.



This needs to be done carefully, as this operation will dictate how co-axial the outrunning magnets will be to the propeller shaft. I used a 3.2mm drill in a hand brace. Using the chuck, the drill can be cut into the brass bushes quite easily.

Drill the rear bush in the brush holder first then temporarily reassemble the brush holder to the empty can. Feed the drill in through the enlarged brush holder bush and carefully open out the front bush. (For some reason I have photographed this drilling operation back-to-front!).

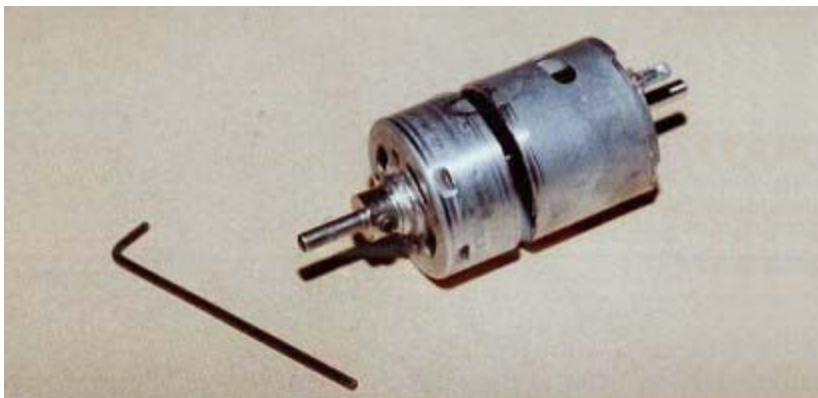
3. Test Fit the Prop Shaft.



This shows the 0.125" drill blank temporarily fitted through the empty motor casing. At this stage the drill blank was to be soldered to the front bush, leaving about 10mm protruding onto which a standard prop adaptor would fit. After spending £20 on various fluxes I still could not solder onto the high-alloy drill

blank. I resorted to using a brass collet soldered square to the front of the bush and the prop shaft would be held in place later with the grub screw.

4. Cut to Size.

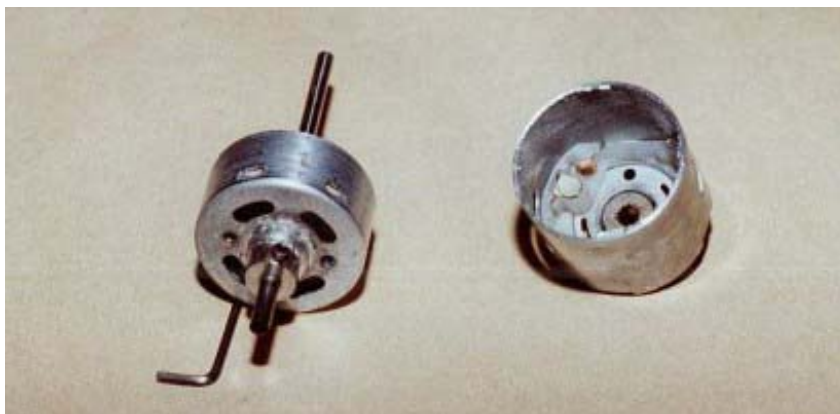


In the above photograph the collet can be seen soldered to the front bush. I ground a small flat into the drill blank for the grub screw to locate against.

The new neodymium magnets will locate against the small dimples which are pressed into the can, which can be seen close to the front face. From the rear edge of these dimples, measure back about 11 to 12mm. This is the cut mark for reducing the can to size.

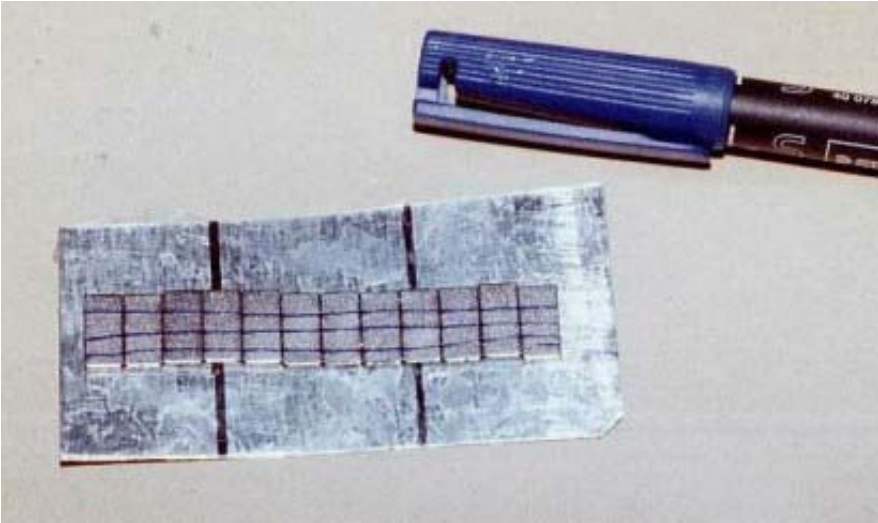
Using a bench-mounted drill, clamp the prop shaft of the motor in the chuck. With the drill running, use a junior hacksaw to slowly cut through the casing. This gives a nice controlled and even cut. It's best not to cut right through using the power drill, but remove the motor casing from the chuck and finish the cut with the casing sitting in the jaws of a vice. The results are quite good after the ragged edges have been smoothed off.

5. Throw Away Some More Bits.



Here, the can is shown cut into 2 parts. The rear portion and brush holder can now be discarded.

6. Sort out the Sticky Magnets.



The neodymium magnets have to be arranged with their poles aligned N-S-N-S-etc and assembled into the motor can in that order. Use a piece of steel to lay out the magnets side by side.

If the poles are opposing they will not sit as shown in the photograph. When all 12 are arranged as shown, mark them suitably.

7. Assemble the Magnets into the Motor.

During the assembly of the motor, I was able to ensure the prop shaft and stator would be accurately concentric with the revolving magnet casing. The mounting of the shaft using the collet and grub screw now allowed the shaft to be withdrawn thus making the magnet placement much easier than otherwise! To space out my magnets evenly I had to experiment with spacers which took a little time to do.



A strip of 1/32" ply was used, onto which I stuck 2 or 3 layers of masking tape. The resulting composite was cut into slivers which were placed one between each magnet (not shown). It is virtually impossible to place the magnets without spacers!

When all the magnets are in position, the spacers can be very carefully removed, relying on the balanced magnetic flux to keep all in position. Initial fixing of the magnets can be done with some thin cyano. This was followed by a mix of epoxy with the whole lot kept warm enough to let the epoxy flow nicely.

If the magnets are too hot to touch they will lose their strength! Final cleaning-up of the epoxy was done before it had fully set using methylated spirit.

8. The Stator.

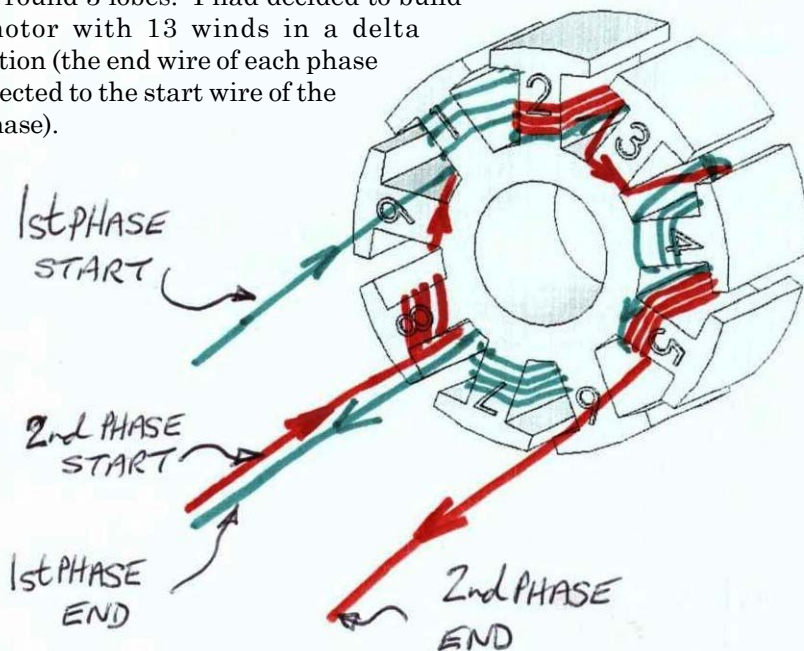
Shown above are the 2 stators, each about 5mm thick. They have been cyno'd together with the lobes lined-up and the bores concentric with the mounting tube. In this case the mounting tube is a piece of aluminium alloy which will take a bearing race in each end of it. About 35mm long is adequate for its purpose. Carbon fibre tube is equally useful for this and is available with an outer diameter of 8mm which is an accurate match to the bore of the stator.



Fit the ball races into each end of the tube, using the drill blank again to ensure that everything is running true. Apply a small amount of cyano or epoxy to the outer race if necessary and allow to set.

9. Winding the Stator.

Start by numbering each lobe of the stator with an indelible pen. I will also consider this numbered face as the front and the opposite side will be the rear. There are 3 separate pieces of wire which have to be wound onto the stator to produce the 3 phases. Each wire will need to be wound round 3 lobes. I had decided to build this motor with 13 winds in a delta connection (the end wire of each phase is connected to the start wire of the next phase).



The first phase is wound starting with stator lobe 1 and will progress onto lobe 4 then lobe 7. It is important to make all the winds in the same direction and to wind the same number of coils onto each lobe (this is surprisingly difficult to do!).

The stator can be held in one hand while winding, which helps.

Beginning at the front of lobe 1, neatly wind on 13 turns of wire starting from the front. Having completed the number of winds, pass the wire then around the front of lobe 2, through the slot between 2 and 3, behind lobes 3 and 4 returning it through the slot between 4 and 5. Complete the winding of lobe 4.

From the final wind on lobe 4, pass the wire in front of lobe 5, through the slot between 5 and 6, behind lobes 6 and 7, returning it through the gap between lobes 7 and 8. Complete the winding of lobe 7. The first phase is now wound.

Take a second length of wire and proceed with winding phase 2. Start by loosely twisting the start of this wire to the end wire at lobe 7, then wind lobes 8, 2 and 5 in that order, following the same plan as for phase 1.

This is phase 2 successfully wound.

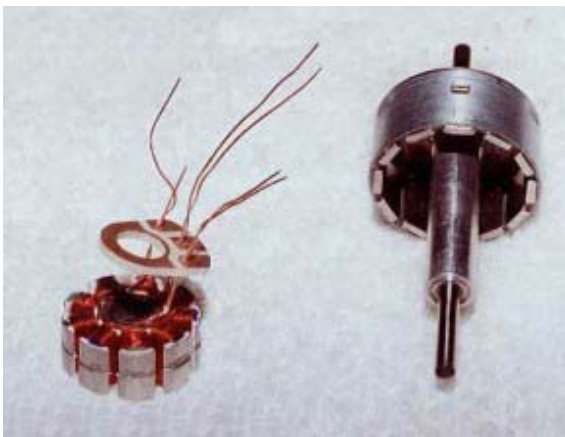
Now take the third length of wire for phase 3 and loosely twist it into the end of phase 2 (lobe 5). Wind lobes 6, 9 and 3. The end wire of this phase will be connected to the start wire of phase 1.

10. Almost Done!

The 3 pairs of wire ends have had the insulation scraped off, and twisted together. These have been fitted through the holes in the solder plate.

With the drill blank fitted, slide the bearing tube over it and carefully fit the wound stator and solder connection plate over this.

Careful - when it gets near the magnets they will grab it!



With the bearing tube fully into the motor can and the stator sitting in its "magnetically balanced" position, run some cyano between stator and bearing tube, and between solder connection plate and bearing tube.

The completed stator can be carefully withdrawn and the wires soldered through the holes in the plate.

11. A Slight Adjustment!

On trying to assemble the motor I found that the stator and rotor were rubbing! This was rectified by mounting the stator assembly in the bench drill and filing

some material off the crests of the stator lobes. Use magnets that are 1.5mm thick and you will avoid this problem!

12. A Finished Motor.

Now running with satisfactory clearance, the connection wires for the speed controller have been soldered onto the solder plate.

For small motors where the stator is only one section of 5mm length, John indicates that the magnetic field alone is sufficient to counter the thrust at the propeller and prevent the motor pulling apart.

For this one with a 10mm stator I will cyano a 10mm length of brass tube to the rear end of the drill blank leaving a whisker of clearance between the tube and the rear ball race.



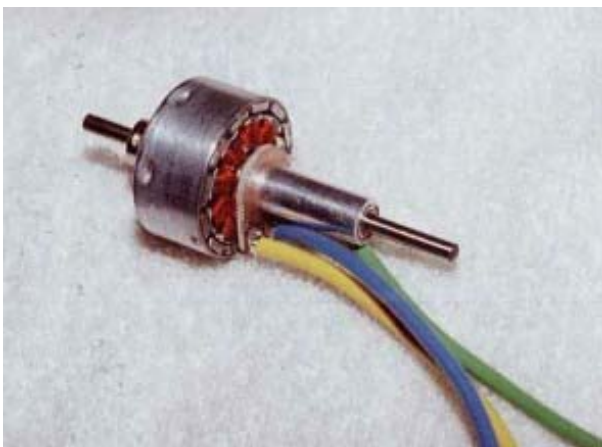
This will be permanently fixed, but this motor can be disassembled from the front if the stator windings need to be modified at any time.

For mounting in a model, carbon fibre tube can again be use. With an inside diameter of 8mm and a saw cut through the wall for a distance of about 12mm in, the CF tube can be clamped to the bearing tube with a small hose clip.

Do an initial test run on the motor with no prop fitted. It should run-up smoothly and quietly with no vibration. Direction of rotation is easily changed by un-plugging any 2 of the 3 wires and swapping them over.

13. Bench Testing!

One of the likely uses of this size of motor will be with 7 cells (where 7 NiCds or NiMH compare favourably with 2 LiPo cells) or 8 cells.



To this end the testing was conducted using a 7-cell and an 8-cell NiCd pack with suitable propellers.

DIY BRUSHLESS OUTRUNNER 400/10-13 WIND ON A HACKER OPTO 40-3P SPEED CONTROLLER

8-Cells

| Propeller | Current (A) | RPM | Thrust (oz.) | Approx. Speed (mph) |
|------------------------------------|----------------|--------|-----------------|------------------------|
| 5" x 5" Microspeed | 9.6 | 15,000 | 10.3 | 75 |
| 5½" x 3" Master Airscrew (cropped) | 8.4 | 15,460 | 10.3 | 46 |
| 5½" x 4" MA | 8.0 | 15,400 | 9.1 | 62 |
| 6" x 3" MA | 9.6 | 14,780 | 12.5 | 44 |
| 6" x 3.5" MA | 9.6 | 14,520 | 11.4 | 51 |
| 6" x 4" MA | 8.9 | 14,730 | 10.3 | 59 |
| 7" x 4" Graupner | 15.0 | 11,800 | 13.7 | 47 |

7-Cells

| Propeller | Current (A) | RPM | Thrust (oz.) | Approx. Speed (mph) |
|--------------------|----------------|--------|-----------------|------------------------|
| 5" x 5" Microspeed | 7.3 | 13,120 | 6.8 | 66 |
| 5½" x 4" MA | 6.3 | 13,700 | 6.8 | 55 |
| 6" x 3" MA | 7.6 | 13,400 | 9.1 | 40 |
| 6" x 3½" MA | 7.8 | 13,210 | 9.1 | 46 |
| 6" x 4" MA | 7.5 | 13,420 | 9.1 | 54 |
| 7" x 4" Graupner | 13.7 | 11,350 | 12.5 | 45 |

Conclusion

The motor is fairly cheap to build and was certainly satisfying in the end result. The 13 wind version seems suitable for what I need it for although I can easily rewind the stator to make changes later.

Any further motor construction will be even cheaper (as I have some material left over) and quicker to build.

Because the motor is a Speed 400 diameter, and also because the wires exit the motor in a position where they cannot be rubbed by the rotating can, it is ideal for the dozens of planes drawn up for Speed 400's. The Typhoon range for instance, has similar performance characteristics, but the diameter is much greater and the wires exit near the front mounting plate and usually have to be routed past the rotating can. This increases the mounting diameter to an even greater extent.

The Sprite

by John Bowerman

I have been designing my own models for about 8 years now, ever since I went fully electric. It started as a challenge because, like many I guess, what I wanted could not be bought commercially, so in order to satisfy myself the only way was to design and build.

I have had a few that could be best described as not that good but in truth not many and all have flown to a greater or lesser degree.

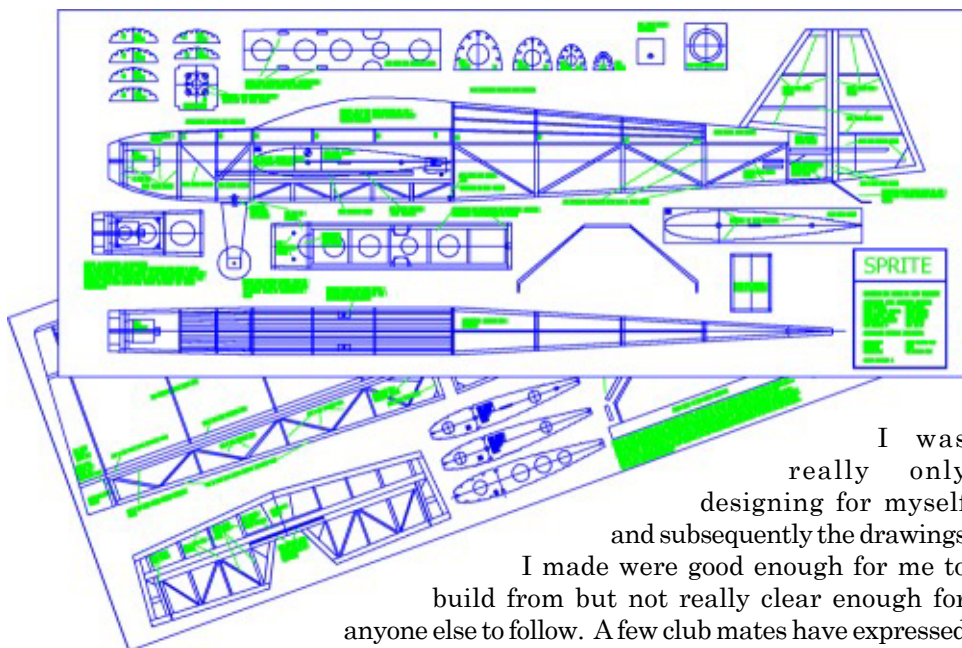
I started by drawing on to paper with large rulers, set squares and compasses but eventually I was able to get hold a decent CAD package and then more importantly a decent sized plotter, courtesy of E-Bay.

These two factors have enabled me to really focus on both the aesthetics of the design and also the accuracy of all the fitted parts and have led to a continued stream of successful flying models.



An excellent shot of the Sprite

E.F.-U.K.



I was really only designing for myself and subsequently the drawings I made were good enough for me to build from but not really clear enough for anyone else to follow. A few club mates have expressed interest in the models and they have then received better drawings with more detail and an attempted list of instructions but until now that is as far as the drawings have gone.

I was flying at the Walsall meet last August when I was approached by Mike Windo who expressed a desire for a set of drawings of the Mark 1 Sprite. We got talking and I agreed to send him a set of drawings of the Mark II from which he could build from. Having made the commitment the problem was then completing my drawings to a standard that another modeller could follow.

Mike living in Cheltenham and me in Milton Keynes meant that he could not just pop in to see how certain bits fitted or be able to see the model at the strip, he would need to understand the drawings if he was to make a successful model. It also transpired that Mike was a retired Drawing Engineer so knew a thing about plans and so forth, I was self taught on AutoCAD, I always did enjoy a challenge!

I am pleased to say that after a period of time the drawings were completed along with photographs of the construction and a detailed suggested build sequence for the model and although it took me longer than I expected, not entirely helped by my day job situation I really did enjoy the process.

It was interesting and enjoyable making sure that everything fitted exactly as it should and that the drawing made sense for some one else to follow.

The history of the Sprite started back in June 2002 after buying one of the then, fairly new to the Market AXi 2820/10 motors. I remember at the time reading a report on the Actro Motors and being very impressed with their performance and

equally as impressed with their cost. Seeing the AXi on the Puffin Stand looked to be a good compromise and more suited to my pocket.

At that time the model was designed around 10 x 1700 cells and it performed well on a 10 x 6 with an all up weight of about 3lb 6 ounces. I had decided on a fairly mid fuselage position for the wing so that it was always a bit of a fiddle to get the wing in situ with all the wires protruding through for the battery hatch etc.

It was at Chester last year that I was tempted to purchase some of the Li-poly's on offer by the All Electric RC Company stand as for £60, at the time for a 3 cell pack at 11.1 and 4000mAh seemed like too good a bargain to miss. The financial controller was in agreement so money changed hands

By substituting the 1700 with the Li poly made a huge difference to the performance of the model. Shaving nearly 6 ounces off the original weight the performance and duration was really more than worth the cost of the batteries.

Having been so pleased with the performance I decided to make another but make a few modifications that I felt would improve the performance and the general convenience of the model.

The major change being the construction of plug in wings, using ¼" diameter Carbon Fibre rods in Aluminium tubes as opposed to the single wing bolted in to the fuselage in the usual style.

The model as presented represents those changes and has more than achieved the design criteria set out in the beginning.

The current set up is now running on an AXi 2820/12 with 3S Hyperion 3700 mAh LiPo and they have taken another ounce off the AUW. I am running a Master Wooden 11" x 7" propeller, which I like very much but am thinking of experimenting with some of the electric propellers to get some better vertical performance.

I am only running at 286W on the ground so have some way to go with the motor before I get any problems so there is a vast scope to improve the vertical. It will



The Sprite on the ground, resting.

hold the vertical at the moment on full power for some time before falling off but I think the limiting factor is me and not the aeroplane.

Having gone this far I can now offer plans and a construction guide, for £10 including UK postage & packing, to anyone who is interested in the model. For more details, contact John Bowerman at johnbowerman@f2s.com (*Editor: I was so impressed with the Sprite I've already got my copy of the plan - just need time to build it. If you don't have internet access, contact me for how to get hold of John*).

Also included with the 2 large plan sheets (shown above) are a comprehensive set of building instructions. These include some photographs to assist in illustrating key points were required.

Specification

| | | |
|--------------------------|--------------------|--------------------------|
| Wing Span | 52.0 in. | 132 cm |
| Wing Chord Root | 13.5 in. | 34.3 cm |
| Wing Chord Tip | 12.5 in. | 31.8 cm |
| Fuselage Length | 50.0 in. | 127 cm |
| Wing Area | 676 sq. in. | 43.6 dm ² |
| Dry Weight | 26 oz. | 0.74 kg |
| AUW (Prototype) | 48 oz. | 1.36 kg |
| Wing Loading (Prototype) | 10.2 oz. / sq. ft. | 31.2 g / dm ² |

Electric Flight Calendar

If you would like details of your event to appear in these pages please send full details to the Editor EF-UK, contact details on page 4. Please bear in mind that this magazine is quarterly so ensure that the details are sent in good time.

For last minute information on events please check out the events list on the BEFA website (www.befa.org.uk). Dates, times and, even, locations of events can change at the last minute. You are strongly advised to check on events with the given contacts before setting out on your journey to any event.

All BEFA flying events require proof of BMFA (or equivalent) insurance and an 'A' Certificate to fly. For fixed wing models, any of the fixed wing 'A' certificates are acceptable. For helicopters, a helicopter 'A' certificate is required.

All flying models must have been satisfactorily flown at least twice since build or repair before flying at a BEFA event.

NO TEST FLIGHTS ON THE DAY

Standing Events

1st Sunday of every month - The **Brighouse Vintage MAC** have been using the small airfield at Tockwith, near Wetherby, Yorkshire for several years, but have recently had noise problems. The field is now all electric and any BMFA Member

is invited to fly there on the First Sunday in each month from 10 to 5pm for a small fee. Do not be put off by the 'Vintage' part they fly anything! There is a concrete runway available and details of the site can be obtained from Derek Haviour on 01422 204 472

April 2006

- 8th **North London MFC Indoor R/C Meeting.** See 14th January.
- 16th **BEFA ElectroSlot and E400 League event** at Pillerton Hersey (OS Grid SP 4922 4918). For more information contact David Perrett on 01455 272 297 or by email at [**d.l.perrett@btinternet.com**](mailto:d.l.perrett@btinternet.com)
- 16th **BMFA NW Area Indoor Fly-in** at the Springfield Sports Centre, Rochdale. Flying from 11am to 5pm, £3 per person, BMFA card must be shown. For more information see [**www.bmfa-nw.org**](http://www.bmfa-nw.org) or email [**KeithAtRochdale@aol.com**](mailto:KeithAtRochdale@aol.com)

May 2006

- 14th **The Tom Taylor Memorial All Electric Fly-In** at Phoenix MFC, "The Old rifle range", off the A12, Pakefield, Lowestoft. The Tom Taylor memorial shield will be presented again to the best model & flight combination of the day. "A" certificate minimum to fly solo & proof of BMFA insurance required. Book in from 9.30, flying from 10.00. BBQ & Raffle. More at [**www.phoenix-mfc.freemove.co.uk**](http://www.phoenix-mfc.freemove.co.uk)
- 21st **BEFA ElectroSlot and E400 League event** at Billesden. For the location or more information contact David Perrett on 01455 272 297 or by email at [**d.l.perrett@btinternet.com**](mailto:d.l.perrett@btinternet.com)
- 26th - 27th **2006 Militky Cup**, Pfäffikon (Switzerland). Open International - Non World Cup Event for F5B (Motor Gliders) and F5F (10 Cell Motor Gliders). See [**www.silentwings.ch**](http://www.silentwings.ch) or contact Emil Giezendanner, Feldstr. 25b, 8330 Pfäffikon, Switzerland. Tel: +41 43 288 84 30, Fax: +41 43 288 80 33 or [**emil.giezendanner@modellflugsport.ch**](mailto:emil.giezendanner@modellflugsport.ch)

June 2006

- 4th **Hayes & DMAC West London Fly-in** at Cranford Park, Hayes. Contact David Chinery at [**DavidDchinery@aol.com**](mailto:DavidDchinery@aol.com) for more info.
- 11th **BEFA ElectroSlot and E400 League event** at Leamington Spa (OS Grid SP 3187 6779). For more information contact David Perrett on 01455 272 297 or by email at [**d.l.perrett@btinternet.com**](mailto:d.l.perrett@btinternet.com)
- 11th **Rolls-Royce Hucknall MAC** electric fly in at Hucknall airfield near Nottingham (M1 exit 26). Pilots and helpers only. Proof of insurance and BMFA 'A' Certificates required. For further details call Neil Barnard on 01332 516 192 or Barry Parkinson on 0115 973 1954.

- 18th **BMFA Southern Area Electric Fly-In** at the Winchester MAC site. See poster on page 62 for more details.
- 24th - 25th **Wings & Wheels** at North Weald Airfield, Nr Epping, Essex, CM16 6AA. See page 10 for more details.

July 2006

- 1st - 2nd **BEFA Middle Wallop Fly-In.** Possibly the largest electric event in the UK. This year there will not be a league event on the Saturday so all 35MHz frequencies will be available on both days. Electric Flight traders are extremely welcome at this event. Unfortunately it is not possible to camp on the site, but there are camping sites in the local area. For more details contact ***befa@rlmahoney.co.uk***
- 2nd **Ebor Silent Flight meeting** on the York Racecourse.
- 9th **Chester "Roodee" Electric Fly-In.**
- 23rd **BEFA ElectroSlot and E400 League event** at Leamington Spa (OS Grid SP 3187 6779). For more information contact David Perrett on 01455 272 297 or by email at ***d.l.perrett@btinternet.com***
- 23rd **Bath SpaRCS All Electric Fly-In** at RAF Colerne, Wiltshire. Airfield site with tarmac runways and grass. No competitions. Proof of BMFA insurance required. Regret no facilities for spectators. Pilots briefing at 1000. For more information contact Bob Partington 01225 891 441 or email ***bob.partington@ukonline.co.uk***

August 2006

- 6th **BEFA Leamington Spa Fly-In**, contact ***secretary@befa.ef-uk.net*** for more information.
- 13th **BEFA ElectroSlot and E400 League event** at York (OS Grid SE 6210 6030). For more information contact David Perrett on 01455 272 297 or by email at ***d.l.perrett@btinternet.com***
- 13th **Fradley Airfield Electric Fly-In**, just off the A38 between Lichfield and Alrewas. 10am to 5pm. Tarmac runway. Electric Fixed Wing only and they require BMFA membership and an 'A' certificate to fly. For more information contact David Orme on 01543 686 230
- 18th - 26th **11th FAI World Electric Flight (F5B & F5D)) Aeromodelling Championship** organised by the Romanian Modelling Federation. The contacts are Mihail Zanciu (***mzanciu@modelism.mcit.ro***) and Marius Conu (***mconu@modelism.mcit.ro***). Postal address: OP6 - CP 56, Bucuresti, Romania. Telephone : +40 213 162 454 and Fax : +40 213 162 454.

20th **Woodspring E-Fly 2006** at the Woodspring Wings Model Airfield in Yatton, near Bristol. As much a fly-in with interested visitors rather than a show. No entrance fee, just £5.00 per car for parking. For more see www.woodspringwings.co.uk/efly.html or contact Bob Everitt on 01275 842 651 or email bobeveritt@tiscali.co.uk

September 2006

3rd **BEFA Hayes Fly-In** at Cranford Park, Hayes, Middlesex.. For more information, contact David Chinery at DavidDchinery@aol.com.

10th **BEFA ElectroSlot and E400 League event** at Billesden. For the location or more information contact David Perrett on 01455 272 297 or by email at d.l.perrett@btinternet.com

16th - 17th **ASPACH** at MFG Aspach e.V., 71546 Aspach. Details by email from info@mfg-aspach.de or internet www.mfg-aspach.de. You can also get more from Robert Mahoney at robert@rlmahoney.co.uk

17th **Pillerton Hersey Fly-In**. Come and have some fun at this relaxed event. All electric flyers welcome & only £2 to fly, proof of insurance required. More details from John Lewthwaite on 01789 740 688.

24th **BEFA ElectroSlot and E400 League event** at Pillerton Hersey (OS Grid SP 4922 4918). For more information contact David Perrett on 01455 272 297 or by email at d.l.perrett@btinternet.com

October 2006

15th **BMFA NW Area Indoor Fly-in**, see 16th April for details.

November 2006

5th **BEFA Technical Workshop & Traders' Fair**, Leamington Spa.

19th **BMFA NW Area Indoor Fly-in**, see 16th April for details.

December 2006

17th **BMFA NW Area Indoor Fly-in**, see 16th April for details.

January 2007

21st **BMFA NW Area Indoor Fly-in**, see 16th April 2006 for details.

February 2007

18th **BMFA NW Area Indoor Fly-in**, see 16th April 2006 for details.

March 2007

4th **BEFA 2007 Annual General Meeting** at Leamington Spa, Warks.

18th **BMFA NW Area Indoor Fly-in**, see 16th April 2006 for details.



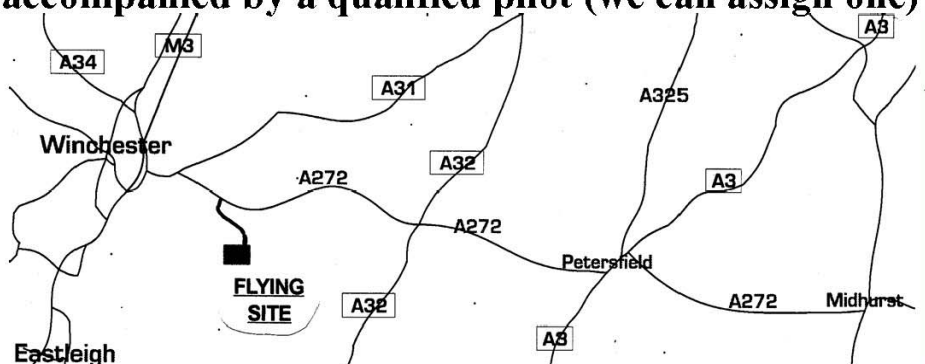
B.M.F.A.

Southern Area

Electric Fly-In

June 18th 10am-5pm

Access off the A272 Winchester to Petersfield road. Trophies for scale aircraft by popular vote and other trophies for outstanding models. Barbecue. Lovely site courtesy of Winchester MAC with large area of short mown grass. Join us for a relaxing fly. Non BMFA 'A' certificate holders will need to be accompanied by a qualified pilot (we can assign one)



All frequencies will be used. Entry fee £3 per pilot.
For more information contact Andy Palmer at 92 Durley Ave,
Waterlooville, Hants PO8 8TZ. Tel: 023 92 253761.
Email: palmer99@tiscali.co.uk



FOR SALE / WANTED

Member's Sales & Wants

The items below are for sale by Trevor Wain, contact at trevorwain@tiscali.co.uk or on 01332 792 508.

- **Puffin Models Elegant**, 2.6m glider / electric glider. Flown twice, but other interests took over - no equipment fitted. Offers around £100.
- **Kontronik Smile 40-6-18 opto, brushless, speed controller**, 40A 6-24V with Kontronik 4mm silver connectors on the output and Schulze 3.5mm connectors on the input and has been used twice. He would like to exchange for the same or very similar with BEC or sell for £65.

Neil Stainton is selling the following items. All are plus postage or can be picked up from Leamington Spa. Contact Neil Stainton on 01926 314 011 or email him at Neil@ITpartnership.com

- New **Blade Runner indoor helicopter**, including 27Mhz R/C, LiPo battery & charger: £35
- **Hornet Helicopter FP VGC**, with carbon blades: £20

Jim Horne has the following items for sale, email Jim at HORNEGb@aol.com or phone 01388 819 638

- **WeMoTec Midi-fan** with **Aveox 36/24/2** sensorless brushless motor £70.
- **FVK RIVAL**, 2.8m span, fitted with a Kontronik 480 brushless with 5:1 gearbox, Hacker 70A ESC, six new servos, Schulze 8 channel receiver, Carbon propeller & spinner, and comes with a 3300mAh flight battery. £450-00 or vno or swap - what have you got?.

Neil Stainton wants a **Highlight Electric Fuselage**, any condition. Contact Neil at Neil@ITpartnership.com or on 01926 314 011

Peter Vivian would like to contact any others in his approximate area (Camberley, Surrey) who are also new to Electric Flying, with a view to mutual assistance and support. Peter returned to model aircraft fairly recently after a 55-year break, with an interest mainly in building and experimenting (definitely NOT ARTF!). He would like to meet up with others having similar interests. Contact Peter by email at PGLV@aol.com or on 01276 21 304

Wanted by the Editor, any of the following (see page 4 for contact details):

- General / Technical Articles.
- Hints & Tips.
- New Product notifications.
- Product Reviews.
- Photographs of your models.
- Electric Flight Event Reports.
- Any other item of interest to electric model aircraft flyers.

Please send colour Digital photos or photographic prints (6" x 4" or bigger) to the editor. If possible, please do not send inkjet prints as too much quality is lost during the printing and scanning process.

If you have no way to email or write the files to a CD, please contact the Editor for other options.

Photographic prints supplied will be returned, unless specified otherwise (as long as you give a return address).

Digital photos should be sent at the highest resolution possible, in colour, and preferably uncompressed. Where compression is unavoidable the camera should ideally be set to the lowest compression possible and at the maximum resolution. Digital photographs can be emailed to the Editor at ***editor@befa.org.uk***

Readers always like to know what equipment is fitted to models so they know what combinations work well (or not so well). Therefore please include as many details of the models in the photographs as possible, but ideally at least wing span, wing area, motor(s), gearbox(es), propeller(s) or fan(s), battery pack(s) used & the flight performance.

Where articles are produced on a word processor package, please include an electronic copy - it make the Editors job much easier and quicker. Ideal formats are Microsoft Word (any version), Works word processor, WordPad or Notepad. Other formats can be accommodated, but please contact the Editor first.

New to ELECTRIC FLIGHT?

START HERE

You may be taking up Electric Flight for the first time or you may be converting from another discipline. Whatever your situation, help and advice is available. BEFA has prepared an information sheet which details further sources of information which you may find useful when just joining the hobby. To receive a copy, please send a Stamped Addressed Envelope (S.A.E.) to Robert Mahoney, address on page 4.

BEGINNER'S GUIDE

A Beginner's Guide to Electric Flight is available, which explains many of the 'Mysteries' of Electrics' and will, hopefully, set you off on the right foot. Please send £3.00 per copy required to The Editor of EF-UK at the address on page 4. Please add £1.00 extra for overseas postage and remit in Sterling. Cheques should be made payable to BEFA.

TECHNICAL HELP SERVICE

Technical help is now available again for the use of all members. We regret that no telephone service is available, but all questions in writing (or email) will be answered by our Technical Liaison Officer (TLO). Please refer your queries to our TLO, to the postal or email address on page 4. If sent by post, please ensure that you include an S.A.E. for a reply.

CONNECTIONS SERVICE

Requests are frequently received from members who wish to be put in contact with other members living in the same area. The easiest method of doing this is to place a free 'wanted' advert in the classified section of this magazine. Alternatively, a request may be made IN WRITING to the Membership Secretary who is allowed to divulge such information to members ONLY. Please supply as much information about your location as possible and please remember to include an S.A.E. for your reply.

B.E.F.A. MEMBERSHIP

Membership of the Association is open to all. Those who are not members of BMFA (our national controlling body) will have a subscription to EF-UK membership with none of the other benefits. Overseas members are very welcome and will be classed as full members if they belong to their own national controlling body.

CONTACT

For full details, please send an S.A.E. to the Membership Secretary (address on page 4) requesting a membership application form. Those with Internet access may visit the B.E.F.A. website at *www.befa.org.uk* where you will find all the membership information you should require and a application form.

B.E.F.A. Sales

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EF-UK Back Issues - Issues 71 to 73 and 75 to 83 are available to BEFA members at £3.00 each, or £5.00 each to non-members. These prices include UK P&P, overseas rates on application. Reprints of earlier issues may be available to special order at slightly higher cost, contact the Editor for details (see page 4).

EF-UK Index. A comprehensive index of EF-UK, from issue 28 to date, is available by sending a £1 coin to cover copying and postage cost.

Binders:- are available to hold 8 to 12 issues of Electric Flight U.K. Produced in dark blue with gold lettering on the spine, these cost £4.50 each including U.K. postage. Please add £1 for European postage and £2 for Worldwide postage.

Please send all orders to The Editor of EF-UK at the address on page 4.

Sweat Shirts & Tee-Shirts: Stock of these is now almost all gone - please contact Robert Mahoney regarding remaining stock, sizes and prices.

**PLEASE REMIT IN STERLING ONLY,
WITH ALL CHEQUES MADE PAYABLE TO B.E.F.A.**

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£20 per full page, £10 per half page, all per issue.

Contact the EF-UK Editor for more details (see page 4).



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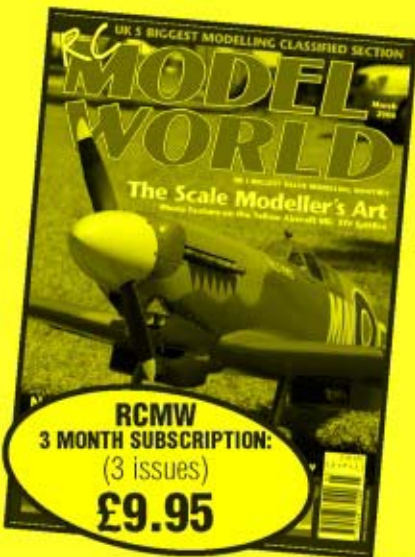


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